THE KANSAS UNIVERSITY SCIENCE BULLETIN.

Vol. III, No. 9—April, 1906.
(Whole Series, Vol. XIII, No. 9.)

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THE UNIONIDÆ OF KANSAS, PART I, ... *Richard E. Scammon.*

PUBLISHED BY THE UNIVERSITY,
LAWRENCE, KAN.

Entered at the post-office in Lawrence as second-class matter.

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THE UNIONIDÆ OF KANSAS, Part I.

AN ILLUSTRATED CATALOGUE OF THE KANSAS UNIONIDÆ.*

BY RICHARD E. SCAMMON.

With plates LXII to LXXXVI.

INTRODUCTION.

THIS paper is the first of a series in which the author will attempt to give an account of our present knowledge of the Unionidæ, or pearly, fresh-water mussels, of the state of Kansas.

It was originally intended to embody this material in a single paper, but in the course of the work it has been found advisable to divide it rather arbitrarily into three parts. The first part, as given herein, is an illustrated and descriptive catalogue of the *Unios* known to occur within the limits of the state; the second will be a discussion of their geographical distribution; the third will contain a description of the soft parts of each species. It is a matter of regret that this last cannot be included in the present paper, but as yet the material at hand is not sufficient to warrant such a report.

The literature dealing with the Kansas Unionidæ is not extensive. Barring a few descriptions of new species† (all of which have turned out to be synonyms), the only work done on the Kansas *Unios* is that of Call, which appeared as a series of six reports in the Washburn Laboratory of Natural Science Bulletin, from 1884 to 1887 (4, 5). These reports consist of a list of some forty-nine species, with notes on their

*Submitted in partial fulfilment of the requirements for the degree of master of arts.

†See bibliography.

distribution and synonymy. While this list will always be of great value to those working on the *Unios* of the western Mississippi region, it is preliminary in its character and hardly available to the average student. Modern synonymy, much of which Doctor Call has himself worked out, has reduced this list to forty species and three subspecies.

In this catalogue are listed sixty-one species and five subspecies. There is no doubt that future collecting will add many more species to this list. The author has tried to make certain of the identification and locality of every species listed, and, with three exceptions,* has examined native specimens of each. In the great majority of cases a large series was available for the study of each species.

The greater part of the material upon which this paper is based was obtained from the collection of the University of Kansas (built up through the efforts of Dr. F. H. Snow) and from the collection of the author from Douglas, Franklin, Johnson, Jefferson and Cherokee counties, and the Neosho river near the state line. Several correspondents over the state have contributed data and material. The author has also examined the collections of the Academy of Science, at Topeka; Ottawa University, at Ottawa; Kansas Agricultural College, at Manhattan; and Washburn College, at Topeka. In the last-named institution is deposited most of the material upon which Doctor Call based his report.

The classification followed in this paper is that of Simpson's "Synopsis of the Naiades" (20), and the description of the genera and higher groups are extracts from that acknowledged authority. Simpson's synonymy has been accepted in all cases save that of *Anodonta bealii*, which the author feels convinced is only another form of the highly variable *Anodonta grandis*. While strongly opposed on principle to varieties or subspecies among the Naiades, the author has adopted a number for the sake of convenience. Only those synonyms which seem to be of the most importance are given. Lindhall's correction of the orthography of the Naiades (24) has been adopted throughout.

As a number of measurements have been given in connec-

**Lampsilis higginsii, Quadrula speciosa, Q. aspera.*

tion with the descriptions, it may be well to define them. The "longitudinal axis" of the shell is considered to be a line drawn through the ventral margins of the large anterior and posterior muscle cicatrices. The longest line which can be passed through the valve parallel to this axis is given as the length of the shell. The height is considered to be the length of the line passing through the umbones of the shell at right angles to the longitudinal axis. By taking this conception of the height, the sex variation of the shells of the higher *Unios* is eliminated from this measurement. It has seemed best to give the position of the umbones in relation to the length of the shell in more definite terms. To secure this relation in numerical terms, a line is dropped perpendicularly from the tip of the umbones to the greatest longitudinal axis, and the distance from the intersection of the two lines to the anterior margin of the valve is given as a decimal fraction of the entire length of the greatest longitudinal axis. This relation has been termed the umboidal ratio.

The two following terms have been employed in the descriptions, and are suggested for general use. First, the word "interdentum," as signifying the plate bridging the space between the pseudocardinals and the laterals; second, the term "branchial outline," as indicating the slight groove to be seen in the cavity of many of the more solid *Unios*, and which is caused by the slightly raised outline of the branchiæ.

The statements concerning the general distribution of each species are derived in the main from Simpson's "Synopsis," and this information is therefore in almost every case to be credited to that author. In considering the distribution within the state, an effort has been made to extend due credit in all cases where exact localities are named. In dealing with this local distribution, Doctor Call's work (4) has been most valuable.

I wish here to express my thanks to those who have aided me in this work. These are due particularly to Dr. C. E. McClung, under whose direction this work was done, and who has by his numerous kindnesses and suggestions rendered it possible. The following gentlemen have kindly per-

mitted me to examine the material under their charge, and in several cases to remove data and material for further study: Professor Wilson, of Ottawa University; Professor Shattuck, of Washburn College; Prof. E. A. Popenoe, of the Kansas State Agricultural College; and Mr. Eugene Smyth, curator of the Kansas Academy of Science.

I have received valuable material for study from Doctor Newlon, of Oswego; Mr. H. T. Martin, of the University; Mr. W. R. B. Robertson, Mr. Brenman, and Professor Smith, of Minneapolis, Kan. Mr. Wm. H. Dall, curator of mollusks, National Museum, has kindly contributed data which is credited in the text.

Although the geographical distribution is left for more extensive treatment in a future paper, the following outline of the hydrography of Kansas is inserted to make clear the geographical references in the notes:

The streams of Kansas reach the Mississippi by two channels—the Missouri river and the Arkansas river. The streams of the state group themselves into three general systems. To the north the Kansas system, consisting of the Kansas river and its tributaries and emptying into the Missouri on its approach to the east state line. This system drains the northern half of the state. The Osage river, together with its tributary, the Marais des Cygnes, drains a triangular area having for its limits the central third of the eastern state line and extending west as far as the ninety-seventh meridian. The Osage flows into the Missouri river about half-way across the state of that name. The southern half of the state is drained in the west by the Arkansas river, and in the east by a number of parallel streams flowing southward which I have called the "clear-water streams" of the southern drainage. These streams eventually join the Arkansas. The most important of these are the Verdigris, the Walnut, the Neosho, and the Spring.

Family UNIONIDÆ.

"Shell nacreous, with a thick epidermis, beaks usually sculptured, often showing the remains of nuclear shell; ligament opisthodetic; hinge with or without teeth, though with vestiges of them in every genus; when present, schizodont, and arranged as pseudocardinals and laterals; pallial line usually simple; prismatic border ordinarily narrow.

"Animal with labial palpi almost always wider than long; anal opening usually separated from the superanal; embryo a glochidium, the soft parts being inclosed in a bivalve shell, and borne in the outer or inner or all four leaves of the branchiæ." (Simpson.)

HETEROGENÆ.

"Male and female shells different. The latter are inflated in the post-basal region; embryos are contained in the ovisacs separated by a sulcus and occupying the hinder part of the outer gills." (Simpson.)

Genus TRUNCILLA Rafinesque, 1819.

"Shell rounded or oval, solid, inflated, generally smooth and rayed with a delicate beak sculpture which has a tendency to be doubly looped, that in the female having a decided inflation in the post-basal region, which is thinner than the rest of the shell, of different texture, often toothed, and usually radially sculptured; laterals double in each valve, the inner in the right valve smaller. Animal generally having the inner gill united to the abdominal sac; female with a heavy flap of mantle which fills the post-basal swelling of shell and which has an inner ridge inside at some distance above the edge; marsupium very distinct, occupying the swollen part of the shell." (Simpson.)

Truncilla triquetra Rafinesque. Plate LXIII, fig. 1.

Truncilla triquetra Rafinesque, Ann. Gen. Sci. Phys. Brussels, XIII, 1820, p. 300, pl. LXXXI, figs. 1–4.

Unio triangularis Barnes, Amer. Jour. Sci., IV, 1823, p. 272, pl. XIII, fig. 17.

Unio formosus Lea, Trans. Amer. Phil. Soc., IV, 1834, p. 111, pl. XIV, fig. 41.

Shell small, fairly solid, roundly elongate, triangular in outline, inflated, females particularly so. Anterior maring projecting and decidedly rounded; ventral margin gently and regularly bowed, posterior margin oblique, straight or slightly rounded; dorsal margin short, straight or slightly curved. Umbones full, high, decurved. Anterior and lateral slopes fully rounded, umboidal ridge well marked; posterior slope abrupt and straight or slightly excavated, marked with numerous fine, continuous, very slightly elevated ridges. Epidermis smooth and shining in most cases, straw-yellow to honey color, strongly marked with rays of dark green made up of arrow-shaped spots. Lines of growth smooth, distinct, and continuous. Ligament short, thick, light or dark brown, lunule rather large.

Interior: Pseudocardinals high, erect, pointed, slightly serrate at the apices, double in each valve. Interdentum narrow and rounded, cut away in the right valve. Laterals short, slightly curved, high, thick. Anterior adductor cicatrix much longer than wide, well excavated. Posterior scars large, well impressed, distinct. Dorsal muscle scars large, three to five in number, located on the lower surface of the interdentum. Pallial line impressed in its anterior two-thirds. Cavity of the beaks and of the shell deep. Nacre milky white.

Height.	Length.	Breadth.	Um. ra.	
32*	0.50	27	0.30	♂

T. triquetra is distributed over the Mississippi region from western New York to Indian Territory. Its only recorded occurrence in Kansas is in the Marais des Cygnes river at Ottawa. It will probably be found throughout the eastern half of the state, although it is without doubt a rare species.

This is a distinctive species which will hardly be confused with any other found in the state. In no other form is the sexual dimorphism more pronounced; the female shell has an inflation which appears almost abnormal.

*All measurements are given in millimeters.

GENUS **LAMPSILIS** RAFINESQUE, 1820.

"Shell oval to elliptical, smooth or slightly concentrically sculptured, usually without a posterior ridge; epidermis generally smooth and shining, often brilliantly rayed; beak sculpture, for the most part, consisting of fine, parallel ridges, which show a tendency to fall into an anterior and a posterior loop; hinge with one or two pseudocardinals and one lateral in the right valve, and two pseudocardinals and two laterals in the left; female shell having a moderate and gradual inflation in the post-ventral region opposite the marsupium. Animal with the inner gills attached nearly or quite through entire length to the abdominal sac; marsupium occupying the hinder part of the outer gills; ovisacs distinct, separated by sulci, rounded below, having a fold near their bases, the whole projecting below the inner gills; mantle edge doubled and thickened, often swollen behind in a sort of flap in the female." (Simpson.)

Lampsilis ventricosa BARNES. Plate LXIII, fig. 2.

Unio ventricosus Barnes. Amer. Jour. Sci. and Arts, No. IV, 1832, pl. XXXII.

Unio occidens Lea. Trans. Amer. Phil. Soc., III, 1829, p. 435, pl. X, fig. 16.

Unio subovatus Lea. Trans. Amer. Phil. Soc., IV, 1831, p. 118, pl. XVIII, fig. 46.

Unio canadensis Lea. Proc. Acad. Nat. Sci. Phila., I, 1857, p. 85.

Shell large, of moderate thickness, subelliptical in females, elliptical in males; females much inflated, males less so. Anterior margin decidedly rounded; ventral margin nearly straight in female, bowed in male; posterior margin often slightly emarginate in the female, roundly pointed in the male; dorsal margin somewhat curved or straight. Umboidal ratio approximately one-third. Umbones large and full, marked with a few coarse ridges. Anterior umboidal slope rounded short; posterior slope long and flat in males, rather short and high in females. Shell generally smooth except in old specimens; lines of growth dark, continuous, imbricated. Epidermis from straw-yellow to dark brown, with a few posteriorly placed dark-green rays in some specimens. Ligament short, stout, black.

Interior: Pseudocardinals high, serrate, directed anteriorly,

two in the left and one (with sometimes an anterior auxiliary one) in the right valve. Lateral teeth short or moderately long, highest posteriorly, slightly curved, anterior adductor cicatrix well impressed, large, much longer than wide, anterior retractor scar of good size, semicircular; posterior adductor well marked, large, about as long as wide; posterior retractor scar large, generally distinct from the adductor cicatrix. Pallial line impressed anteriorly. Dorsal scars form a prominent pitted line on the under surface of the interdentum. Cavity of beaks and shell very large. Nacre satin white, iridescent dorsally and posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
75	49	32	0.30	130°	♂	(Coll. K. A. S.)
108	72	51	.28+	144°	♂	(430.1).
145	97	.....	.30	150°	♀	(Coll. K. S. A. C.)
93	64	48	.34	142°	♀	(431.1).
107	74	62	.30	142°	♀	(62.1).

Lampsilis ventricosa var. **satura** LEA. Not figured.
Unio satur Lea, Proc. Amer. Phil. Soc., v, 1852, p. 252.

To be distinguished from the typical species by the more delicate shell, and by the darker epidermis, which often has an olive-green cast. The anterior slope is generally longer and the posterior more truncated than in the species proper.

This species is found all over the Mississippi drainage and in the St. Lawrence system and Nelson river and its tributaries. The variety *satura* is found in the Southwest to the Sabine river, Texas. It has been reported from all the main rivers of the state. In the Kansas drainage system it is not common. Cragin has reported it from the Kansas river, at Topeka, and from Shunganunga creek, in Shawnee county. Popenoe, however, has never found it in the west-central part of the system in the course of his rather extensive collecting there. In the Wakarusa river, near Lawrence, it is a rare shell, and it has never been found in the Kansas at that place. In the Marais des Cygnes drainage this form is quite abundant, and it is still more so in the larger streams of the southern area. The animal prefers deep water and a muddy bed, although it is found in ripples. The distribution of the variety is coextensive with that of the species. As

Call has suggested (5), the difference between the two forms is probably dependent directly on individual habitat.

The sexual dimorphism is particularly striking, the inflated and sometimes posteriorly truncated females being readily distinguished from the longer and more flattened males. The decided variation in the color of the epidermis and the number and prominence of the lines of growth bear no relation to the sex. There is some variation in the thickness of the shell.

Lampsilis luteola LAMARCK. Plate LXIV, fig. 2.
Unio luteola Lamarck. An. sans Vert., VI, 1819, p. 79.

Shell large, of variable thickness, subelliptical, males slightly inflated, females decidedly so. Anterior margin rounded; ventral margin straight, often slightly bowed, much produced posteriorly in the female; posterior margin bluntly rounded in the male and obtusely angulate in the female; dorsal margin almost straight and meeting the posterior at an angle of from 145 to 150 degrees. Umboidal ratio from 0.15 to 0.25. Umbones prominent, somewhat inflated, marked by from eight to sixteen sharp undulate ridges. Epidermis smooth or rough, according to station, lines of growth prominent and continuous, color variable, generally straw yellow, sometimes rayed over the posterior portion of disk with bands of sage-green of variable thickness and frequency. Ligament stout, long, deep brown.

Interior: Pseudocardinals high, lamellar or columnar serrate, directed anteriorly, two in the left valve and one (and sometimes two) in the right. Laterals of moderate length, thin, highest posteriorly, slightly curved. Anterior adductor cicatrix large, well impressed, variable as to shape, but much longer than wide, retractor cicatrix large and well impressed. Posterior scars large, lightly impressed, often fused. Dorsal scars small, pits scattered over the cavity of the umbones. Pallial line well impressed anteriorly and well marked posteriorly. Cavity of beaks shallow, of shell rather large. Nacre white, sometimes slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Ventral posterior angle.	Dorsal posterior angle.		
119	56	38	0.25	107°	146°	♀	(72.1)
90	45	33	.25+	104°	152°	♀	(70.2)
*136	60	60	.19+	110°	150°	♀	(70.5)
128	62	45	.21+	146°	150°	♂	(6.1)
134	58	47	.18+	155°	145°	♂	(70.3)
131	56	45	.22+	127°	148°	♂	(70.6)

The general range of *Lampsilis luteola* is the Mississippi drainage southwest of the Brazos river, Texas, and Canada east of the Rocky Mountains. It is perhaps the most abundant and best distributed of the Kansas *Unios*, being a common species in all the drainage basins. Its reported western limit of range is the Blue river, at Manhattan (Popenoe), but doubtless it is to be found much farther west. I have reports of its occurrence from nearly 100 localities and I never visited a stream of any size in eastern Kansas along whose banks there were not to be found shells of this species.

L. luteola is a mud-loving species, and is most abundant in the larger and more sluggish streams. It is found in company with *L. anodontoides*, but it does not follow that species into the smaller tributaries.

The male and female shells differ not only in the posterior swelling of the valves but also in the relation of the lower posterior margin to the ventral one. In the female shells the angle between these two is approximately 105 degrees, in the males 145 degrees. The young female shells are often enormously distended posteriorly.

This species is often confused with *L. anodontoides*. The females of *luteola*, however, can be easily recognized by the great posterior swelling, and the males by their more rounded posterior margins and wide and heavy shells.

Lampsilis powellii LEA. Not figured.

Unio powellii Lea, Proc. Amer. Phil. Soc., v, 1852, p. 252; Trans. Amer. Phil. Soc., v, 1853, p. 270, pl. XIX, fig. 25.

Shell large, rather thin, elliptical in outline, neither inflated nor compressed. Anterior margin almost circularly rounded; ventral margin gently and evenly bowed; posterior margin roundly biangulate; dorsal margin rather long and straight. Umboidal ratio in specimens examined, 0.20.

*An unusually swollen female.

Umbones rather flattened. Anterior and lateral slopes flattened and rounded; posterior slope very slightly excavated and marked with two radial lines. Epidermis smooth and generally shining, olive-brown. Ligament long and rather thick.

Interior: Pseudocardinals small, serrate, rather bluntly pointed, single in the right and double in the left valve. Laterals long, slightly curved, lamellar. Interdentum long, narrow, rounded. Anterior adductor cicatrix well impressed, large, much longer than wide; posterior scars large, very lightly impressed, confluent. Dorsal cicatrices on the lower surface of the interdentum. Pallial line well impressed in its anterior one-half and crenulate. Cavity of the beaks deep, of the shell moderately deep. Nacre white, decidedly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
110	0.50	39	0.20	146°	♂	(432.1)

L. powellii is a southern form, found from Guadalupe river, Texas, to the rivers of southern Kansas. It has been found in Spring river at Baxter Springs (Call), and a single male specimen was among a lot of material received by the author from Doctor Newlon and collected from the Neosho river at Oswego. Call (5) mentions that his specimen bears broad brownish rays over the dorsal slope. My specimen is too decorticated in this region to show this character, if present. Lea states that the shell is eradiate. *Powellii* can be distinguished from *L. luteola*, its nearest ally in local waters, by the smaller and less pointed pseudocardinals and the thinner, squarer and less inflated shell.

Lampsilis ligamentina LAMARCK. Plate LXV, fig. 2.

Unio ligamentina Lamarck. An. sans Vert., VI, 1819, p. 72.

Shell large, moderately thick—quite thick anteriorly—wide, elliptical, slightly compressed. Anterior margin rounded; ventral margin more or less bowed; posterior margin roundly triangulate; dorsal margin slightly curved. Umbones slightly inflated and marked with from five to ten fine undulated ridges. Anterior umboidal slope rather sharply rounded, umboidal ridge prominent and obtusely angled. Epidermis marked

with numerous continuous coarse lines of growth which soon lose the triangulate character of the posterior margin as they approach the umbones, and so form one rounded curve posteriorly. Epidermis dark straw color in the young specimens and deep brown in the old; dark green rays of variable width run from the beaks to the ventral margin in young specimens and sometimes occur obscurely in old ones. Ligament very large, robust, dark brown.

Interior: Pseudocardinals massive, rather low, rounded serrate, double in the left and right, the right anterior being rudimentary. Laterals of variable length, curved, coarse, serrate. Interdentum of very variable length and width. Anterior adductor cicatrix deep, longer than wide, rough, set under the anterior pseudocardinal in the left valve; protractor cicatrix longer than wide, quite deep. Posterior scars large, impressed, confluent. Pallial line impressed anteriorly. Dorsal muscle scars large and deep, in the cavity of the beaks or on the lower surface of the interdentum, sometimes on the base of the anterior pseudocardinals. Cavity of the beaks moderate, of the shell rather large. Nacre, satin-white to salmon-pink, the last less common, somewhat iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
98	55	37	0.19	(480.1)
121	62	50	.18	(200.6)
98	60	39	.24	(490.1)
132	65	66	.26	(200.5)

Lampsilis ligamentina var. **gibba** SIMPSON. Not figured.

Unio crassus Sowerby, Conch. Icon, XVI, 1868, pl. XCV, fig. 520.

Lampsilis ligamentinus, var. *gibbus* Simpson, Proc. U. S. Museum, 1900, vol. XXII, p. 540.

To be distinguished from the true species by the greater prominence of the umboidal ridge and the fusing into one curve of the posterior and dorsal margins. This gives the specimens a peculiar humped appearance. The variety is generally smaller and darker colored, and the nacre is more frequently tinted with salmon.

Ligamentina is found in the entire Mississippi drainage, southern Michigan, western New York, and Ontario. The variety *gibba* occurs south from the Ohio river. The species proper occurs in all the Kansas drainage systems, but in the

Kansas river system it is uncommon. Cragin has reported it from Mill creek, Wabaunsee county, and it is occasionally found in the Wakarusa river. In the Marais des Cygnes and the eastern and southern rivers it is quite common, in fact, one of the most abundant shells in the latter. It has not been reported from the Arkansas river. The variety is confined to the eastern rivers of the southern drainage, where it is often more abundant than the true species.

Lampsilis higginsii LEA. Not figured.

Unio higginsii Lea, Proc. Acad. Nat. Sci. Phila., IX, 1857, p. 84.

"Shell thin, oblique, ventricose, very much unequilateral, rounded anteriorly, hinge fairly heavy; beaks very prominent, full, incurved; epidermis olive-green, polished, very much rayed; cardinal teeth large, heavy, erect, crenulate, double in either valve; laterals fairly long, moderately heavy, almost straight; nacre either white or tingedwith salmon color." (Lea.)

L. higginsii ranges from Ohio west to Iowa, and thence to Kansas, according to Simpson. A specimen of this species from the Blue river is in the National Museum (Dall). The description given above is a translation of the Latin one published by Lea in the proceedings of the Philadelphia Academy of Science for 1857.

Lampsilis anodontoides LEA. Plate LXIV, fig. 1.

Unio anodontoides Lea. Trans. Amer. Phil. Soc., IV, 1834, p. 81, pl. VIII, fig. 11.

Shell of moderate size, fairly solid, oblong anterior margin shortly rounded; ventral margin slightly curved, somewhat produced in females; posterior margin roundly pointed in males, blunt in females; dorsal margin straight or slightly curved and joining the posterior at an angle of from 150 to 160 degrees. Umboidal ratio, 0.20. Umbones prominent, and marked with from eight to ten slightly double-looped ridges. Anterior umboidal slope quite abruptly rounded; lateral slope rounded and marked by a broad and exceedingly shallow furrow, ventrally in females. Posterior umboidal ridge well marked; posterior slope very abrupt in old specimens, and often slightly excavated. Epidermis, from pale

straw to rich yellow, radiate rather obscurely in the young; the rays hardly visible in old specimens. Epidermis smooth and shining in the young, roughened with dark, continuous lines of growth in old shells; posterior slope much roughened. Ligament long, rather thick, dark brown.

Interior: Pseudocardinals double in the left, and single, with sometimes an auxiliary; in the right, erect, thin, plate-like, slightly serrate at their tips. Laterals long, thin, straight, or nearly so. Anterior large, moderately impressed, elongate, fan-shaped. Posterior scars lightly impressed, confluent, rather large. Dorsal scars irregular as to numbers and position in umboidal cavity. Pallial line impressed for anterior third or fourth. Cavity of beaks slight, of the shell considerable. Nacre pearly white, often pink, in the central cavity, quite iridescent.

Length.	Height.	Breadth.	Dorsal-posterior. angle.	D. p.-D.v. angle.	Um. ra.		
110	52	43	153°	67°	19+	♀	(68.1)
78	38	20	157°	63°	.22	♀	(122.1)
104	48	41	160°	76°	.18	♂	(66.1)
105	47	44	154°	.....	.21+	♀	(4.1)
108	45	38	161°	.....	.21	♂	(69.1)

This species is distributed over the Mississippi drainage and the Gulf drainage from Florida west into Mexico. It is common in all the Kansas drainage systems, but most abundant in the Kansas basin. Its western reported range in the state is Kingman (Call), in the Arkansas drainage, and Wildcat creek, Riley county (Popenoe). It lives preferably in muddy or sandy beds, and is found in rivers and streams of all sizes, often ascending into the smallest tributaries. It is quite active in its movements and is a rapid burrower. In spite of its adaptability to environment, as shown by its wide distribution, *L. anodontoides* is not a hardy species. It is one of the first to die when kept in an aquarium.

This species was among a lot of *Unios* found in the Pleistocene on Hell creek, in Gove county, of this state, by Mr. H. T. Martin, of Kansas University. The specimens turned over to me were typical *anodontoides*, and were in a fair state of preservation. Mr. Martin states that these forms are undoubtedly of Pleistocene and not recent origin, and were

found associated with vertebrate remains of Pleistocene fauna.

Anodontoides is quite constant in its characters. The sexual dimorphism, however, is well marked, as in all the higher members of the genus *Lampsilis*, by the post-basal swelling of the female shell. This species is liable to confusion with *L. recta* and still more so with *L. fallaciosa*, to which it is very closely related. A statement of the principal differences will be found in the notes on the latter species.

Lampsilis fallaciosa (SMITH) SIMPSON. Plate LXVI, fig. 1.

Lampsilis fallaciosus Smith, Bull. U. S. Fish Com., 1899, p. 291, pl. LXXXIX; Simpson, Proc. Acad. Nat. Sci. Phila., 1900, p. 74, pl. II, fig. 5.

Shell of moderate size, rather thin, decidedly elongated. General outline similar to that of *L. anodontoides*, but the point of the posterior margin is placed more dorsally. Umboidal ratio, 0.18 to 0.24. Umbones low and somewhat flattened, their sculpture of broad ∧-shaped lines, very pronounced, Umboidal slopes similar to *L. anodontoides* but with a more rounded umboidal ridge Epidermis smooth and shining, a clear yellow, with umbones of an ashy tinge, almost always strikingly rayed with thin bands of grass- or bice-green; the rays often fused to make the posterior umboidal slope solid green. The laterals and pseudocardinals of the same character of *anodontoides* but lighter. Nacre almost always salmon tinted in the shell cavity of the male but generally white in the female, iridescent.

Length.	Weight.	Breadth.	Um. ra.	Dorso-ventral angle.		
88	38	30	0.22+	162°	♂	(121.1)
79	33	28	.23—	160°	♂	(404.1)
81	37	30	.19	155°	♀	(121.1)

This species is found in the upper Mississippi drainage south to Tennessee and Arkansas. There is no doubt that it is also to be found in the other drainage basins of the state, although I have seen specimens of it only from the Kansas drainage. As Call's *anodontoides* includes both *anodontoides* and *fallaciosa*, the later species having been established quite recently, it is impossible to tell anything about the respective range of the two species from his list.

Fallaciosa stands very close to *anodontoides*, and may yet be regarded as a variety of that form. The latter is a heavier, coarser shell, with a more pronounced umboidal ridge, less umboidal sculpture, and a duller color than *fallaciosa*. The relation of the height to the length of the shell of *anodontoides* in a series of Kansas shells was 1 : 1.95; the similar relation in *fallaciosa* was 1 : 2.30. The shell of the latter is much more brilliantly rayed and the female is more produced. Simpson states there is a horny raised ridge on the inside of the mantle behind which is not present in specimens of *anodontoides*.

Lampsilis recta LAMARCK. Plate LXVI, fig. 2.

Unio recta Lamarck. An. sans Vert., VI, 1819, p. 74.

Shell large, thick, thickest anterior to the umbones, elongate, moderately compressed, females produced posteriorly. Anterior margin nearly circular; ventral very slightly bowed, much produced in females; posterior margin pointed at an extremely variable angle; dorsal margin slightly curved and meeting the posterior at an approximate angle of 160 degrees. Umboidal ratio, from 0.16 to 0.22. Umbones small and full, marked with fine concentric ridges. Anterior and lateral slopes rounded. Umboidal ridge prominent and continuously rounded. Posterior umboidal slope narrow and abrupt. Epidermis smooth and shiny, very dark brown to black in adult shells; young shells marked with wide olive-green rays over the entire shell; old shells eradiate. Lines of growth numerous, rounded, continuous. Ligament long, stout, dark brown.

Interior: Pseudocardinals, high, erect, columnar or high pyramidal except for the left posterior, which is often plate-like, serrate, double in the left and sometimes in the right, the anterior right when developed sharp and spine-like, the posterior right large; laterals long, high, straight or slightly curved; anterior adductor cicatrix of moderate size and excavation, narrow, fan-shaped, sometimes set slightly under the anterior left pseudocardinal; retractor cicatrix, large and semicircular in outline. Posterior cicatrices of moderate size, lightly impressed, much longer than wide, confluent. Pal-

lial line impressed the anterior half. Dorsal cicatrices a long, narrow pit on the inner surface of the interdentum, often with auxiliary pits in the cavity of the umbones. Nacre variable, white, salmon-pink, rarely purple.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	Angle of posterior point.		
149	66	42	0.28	162°	62°	♂	(164.1)
130	47	34	.18	157°	65°	♂	(120.1)
148	59	42	.21	155°	103°	♀	(65.2)
135	60	44	*.19	152°	54°	♂	(5.1)
142	56	56	.18	163°	60°	♀	(165.3)

L. recta is present all over the Mississippi, the Alabama and the St. Lawrence drainage systems. It is also found in Michigan and the Red River of the North. In Kansas its distribution is peculiar. In the rivers of the southern area it is abundant, and it is also common in the Marais des Cygnes system. In the Kansas system, however, it is confined to the western tributaries; only one specimen has been reported from below Mill creek, in Wabaunsee county, about 120 miles from the juncture of the Kansas with the Missouri river. The one specimen was a fine male and was found in the Wakarusa river, near Lawrence. Above Mill creek the species is fairly common. This peculiar distribution will be discussed in a later paper. *Recta* is not choice of its location, being found either in deep or shallow water and in a gravel or mud bottom.

L. recta is not a variable species, aside from the decided irregularity in the color of the nacre. The shining black epidermis will distinguish it at once from *L. anodontoides* and *L. fallaciosa*, to which it is very closely related. It is a lighter shell than *Unio gibbosus*, which it somewhat resembles in form, and its beak sculpture is entirely different, that of *recta* being made up of fine and numerous loops, while the ridges of *gibbosus* are few and coarse.

Lampsilis subrostrata Say. Plate LXVII, figs. 1, 2.

Unio subrostratus Say, New Harm. Diss., Jan. 15, 1831.

Unio topekaensis Lea, Proc. Acad. Nat. Sci. Phila., XII, 1868, p. 144.

Shell rather small, long ellipsoid, rather thin, females slightly swollen, males somewhat compressed. Anterior mar-

*Not accurate; a broken shell.

gin rather squarely rounded; ventral margin gently bowed, slightly emarginate and produced in females; posterior margin bluntly pointed, decidedly dorsally in female, sharply pointed in male; dorsal margin straight, very slightly oblique, meeting the posterior at an angle of from 150 to 165 degrees. Umboidal ratio, near 0.20. Umbones rather low, directed slightly forward, and heavily marked with a series of broad, slightly curved ∧-shaped ridges, eight to ten in number. Epidermis marked with numerous fine continuous lines of growth, from light brown to dark, rusty brown, the lighter specimens rayed posteriorly with broad bands of green. Ligament light brown, rather long, thin.

Interior: Pseudocardinals double in the left, single and sometimes double in the right valve, variable, generally thin and lamellar, but occasionally pyramidal; erect, finely serrate, left anterior generally twice as long as the left posterior and set on a diagonal parallel to it. Lateral teeth long, thin, slightly curved. Anterior adductor cicatrix well excavated, much longer than wide; retractor cicatrix large and well impressed. Posterior cicatrices variable, large, lightly impressed, confluent. Dorsal muscle scars from one to six, variable in position. Pallial line faint posteriorly but well marked anteriorly. Cavity of beaks shallow, of the shell rather large. Nacre white with considerable iridescence.

Length.	Height.	Breadth.	Um. ra.	Dorso-posterior ventral angle.	Dorsal posterior angle.		
65	31	23	0.18+	60°	161°	♂	(11.1)
64	31	22.5	.21	66°	162°	♀	(40.1)
33	16	8.5	.19+	59°	153°	♂	(9.1)
60	29	21	*	60°	160°	♀	(11.2)
47	23	17	.22	70°	156°	♂	(402.1)

L. subrostrata is found in eastern Texas and as far north as latitude 41 degrees in the Mississippi drainage. In Kansas it is found in all the drainage basins and is fairly common in all of them. The species has been reported as far west as Ellis (Call). *Subrostrata* is a lover of mud beds and quiet waters. It occurs in permanent ponds and lakes as well as streams. In the southern drainage, while quite common in the quiet streams which flow into the larger rivers, it is not common in the rivers themselves. The very characteristic pointed

* Umbones too worn to determine accurately.

posterior margin will render this an easily identified species. It is interesting to note that Lea, in 1868, described a form of this species from the Kansas river as *Unio topekaensis*.

Lampsilis ellipsiformis CONRAD. Plate LXV, fig. 1.

Unio ellipsiformis Conrad, Monog., VIII, 1836, p. 60, pl. XXXIV, fig. 1.
Unio spatulatus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 164.

Shell small, subsolid elliptical, slightly inflated. Anterior margin fully rounded; ventral margin slightly bowed; posterior margin roundly pointed; dorsal margin curved, curving into the dorsal posterior margin. Umboidal ratio, about 0.30. Umbones flattened and ornamented with several coarse, slightly doubly looped ridges. Umboidal slopes flatly rounded, posterior umboidal ridge not sharply marked. Epidermis smooth and shining, yellow with numerous well-marked dark green rays of variable width, wavy posteriorly. Lines of growth coarse, dark, and continuous. Ligament stout and elongate.

Interior: Pseudocardinals ragged, erect, bluntly pointed, double in both valves; teeth of equal size in the left valve, anterior tooth the smaller in the right valve. Laterals short and fairly curved. Interdentum of moderate length, narrow, and rounded. Anterior adductor cicatrix well excavated, of moderate size, semiellipsoid in outline; posterior scars well impressed, large, fused. Dorsal muscle scars few in number, large, placed on the cavity of the beaks. Pallial line distinct for the anterior two-thirds. Cavity of the shell small, of the beaks very slight. Nacre white, silvery posteriorly.

Length.	Height.	Breadth.	Um. ra.		
56	32	18	0.29	♂	210.1
58	32	19.5	.29+	♂	Coll. W. Coll.

L. ellipsiformis occupies the Mississippi valley north of thirty-eight degrees, and also is found in southern Canada and the Red River of the North. In Kansas it has been reported only from the Marais des Cygnes river, but seems fairly well distributed up and down that stream. Its favorite habitat is strictly mud banks. The only species with which this form will be confused is the young of *L. ligamentina*. It has, however, a more elongate and compressed shell than have the young of that species.

Lampsilis parva BARNES. Plate LXVII, fig. 3.

Unio parvus Barnes, Amer. Jour. Sci. and Arts., VI, 1823, pl. XIII, fig. 18.

Shell small, elliptical, thin, inflated. Anterior margin rounded; ventral margin gently bowed; posterior margin rounded; dorsal margin straight, meeting the posterior at an angle of from 140 to 150 degrees. Umbones placed well forward, large and a little inflated, ornamented with five or six coarse concentric ridges. Anterior umboidal slope well rounded, posterior slope less so. Epidermis smooth, generally dull and cloth-like, eradiate, hair brown, with sometimes a greenish cast marginally; umbones often of a lighter shade. Lines of growth numerous, continuous, fine, often darker in color.

Interior: Pseudocardinals double in the left valve and single or double in the right, fine, triangular, erect, the anterior right, when present, small and feeble. Laterals long, straight, thin. Anterior adductor scar well impressed, longer than wide. Posterior cicatrices large, lightly outlined, confluent. Pallial line impressed anteriorly. Dorsal scars few and placed in the cavity of the umbones. Lines of growth show on the inside of the shell as concentric rounded ridges. Cavity of beaks moderately large, of shell large. Nacre white, iridescent.

Length.	Height.	Dorsal posterior angle.	Breadth.		
30	16	16	157	♀	(142.1)
28	16	15	148	♀	(141.1)
18.5	10	6.5	139	♂	(141.2)
22	12	9	145	♂	(141.3)

L. parva ranges from western New York and southern Canada throughout the Mississippi valley to eastern Texas. It is found in all the Kansas drainage systems, and has been reported from as far west as Big creek, at Ellis (Call). It is not an uncommon species in the eastern portion of the Kansas area. Its habitat is muddy and sluggish streams. It burrows several inches into the mud.

This is the smallest species found in Kansas, the average length being about an inch. The females are much more inflated than the males. The small size and heavily undulated beaks will serve at once to identify it. A very near

ally of this form, *texasensis*, probably will be found in the southern rivers of the state. It is to be distinguished from *parva* by the more pointed posterior margin.

Lampsilis alata SAY. Plate LXVIII.

Unio alatus Say, Nich. Encyc., II, 1816, pl. IV, fig. 2.

Shell large, subsolid, alate, slightly inflated. Anterior margin rather pointedly rounded; ventral margin straight, slightly bowed; posterior margin straight centrally, rounded at the ends, set at a variable angle with the posterior margin; the upper end of the posterior margin on a level with the umbones. Wing generally high and thin, triangular in outline. Umboidal ratio very variable. Umbones depressed, ornamented with one or two minute concentric ridges. Umboidal slopes flatly rounded. Epidermis smooth but with numerous growth lines, which become imbricated and broken into two or three shallow waves at the base of the wing. Color variable, parrot or sage-green, horn color to chestnut brown or black in old specimens; obscure rays of dark green are present in young specimens.

Interior: Pseudocardinals generally thin, erect, serrate, double in both valves; posterior pseudocardinal the larger in the right valve; in the left valve both teeth of about equal size. Lateral teeth short, gradually becoming higher and thinner, posteriorly straight or very slightly curved. Anterior muscle scars large, striate, deeply impressed. Posterior scars large, wider than long, outlined only, confluent. Pallial line impressed for a short distance anteriorly. Dorsal muscle scars large and shallow, arranged in a diagonal row across the umbone cavity. Cavity of umbones and shell shallow in males, deep in females. Nacre purple, mauve, salmon-pink.

Length.	Height.	Breadth.	Ventral posterior angle.	Um. ra.		
124	75	46	86°	0.24+	♀	(130.1)
115	64	34	105°	.32	♂	(13.1)
137	73	45	110°	.21+	♀	(131.1)
125	70	55	100°	.22+	♀	(135.1)
112	55	35	89°	.18	♂	(12.1)

The general distribution of *L. alata* covers all the Mississippi valley as far south as Arkansas. In Kansas it is not an abundant shell. In the Kansas drainage, the area in

which it is most common, the shell has been reported as far west as the Solomon river. It is sometimes found in the Marais des Cygnes, at Melvern, and from there east. It is reported only from the Neosho river and its tributary, Fall river (Popenoe), in the southern drainage. Here it is replaced in the main by *L. purpurata*, which is better fitted to survive the conditions present there. Its habitat is muddy river-beds, in deep water—generally confined to the larger streams.

When in good condition this is one of our most beautiful *Unios*. The variation is confined principally to the color of the epidermis and the nacre. This has been covered in the description above. *Alata* may be confused with two other forms—*L. purpurata* and *lævissima*. From *purpurata* it may be separated in well-preserved specimens by its high wing, but in old specimens this is often almost gone. It is, however, a lighter shell, less swollen, and almost square behind, while *purpurata* is rounded. The pseudocardinals are lighter in *alata*. *Lævissima* is much thinner and more rounded than *alata*, and the pseudocardinals in the former are reduced to a thin erect plate in each valve.

Lampsilis purpurata LAMARCK. Not figured.

Unio purpurata Lamarck, An. sans Vert., VI, 1819, p. 71.

Unio ater Lea, Trans. Amer. Phil. Soc., III, 1830, p. 426, pl. VII, fig. 9.

Shell large, fairly thick, particularly anteriorly and outside of the pallial line, elliptical slightly alate; females inflated, males less so. Anterior margin projecting and decidedly rounded; ventral margin straight, showing a very slight tendency to become emarginate centrally; posterior margin rounded, but tending to become biangulate dorsally; dorsal margin a low, thick wing. Umboidal ratio, 0.15 to 0.30. Umbones large, swollen, rounded, marked in young specimens with a series of five or six ∨-shaped ridges. Umboidal slopes all fully curved, lateral showing a very faint furrow ventrally; on the posterior slope are two more or less distinct raised lines running from umbone to posterior margin. Epidermis smooth and shiny over and below the umbones, but roughened by the imbrications of the lines of growth margin-

ally. Lines of growth fairly continuous. Epidermis dark brown to black, eradiate in old specimens, obscurely marked with wide, dark green rays in young. Ligament long, light brown, stout.

Interior: Pseudocardinals double in both valves, rather high, very ragged, pyramidal, sometimes directed anteriorly. Laterals of moderate length, thick, high, slightly serrate, a little bowed. Anterior adductor cicatrix ray deeply impressed, large. Posterior cicatrices large, moderately impressed, wider than long, confluent. Pallial line impressed for the first two-thirds of its length. Dorsal cicatrices large, situated in the cavity of the umbones, variable as to number and arrangement. Cavity of umbones moderate, of shell rather deep, particularly in female. Nacre a light pinkish purple, shiny and iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.		
141	72	61	0.22	♀	(324.1)
123	61	46	.18+	♂	(325.1)
121	60	47.5	.21	♀	(324.2)
88	49	44	.28	♀	(325.2)
78	46	34	.26+	♂	(325.3)

L. purpurata is a southern species, ranging as far north as northern Kansas and southern Missouri and from eastern Texas to the Alabama drainage. It is present in all the drainage systems of Kansas, but is most abundant in the southern rivers. It has been found as far west as the Solomon river in the Kansas drainage.

In the Kansas and Marais des Cygnes areas it is fully as common as *L. alata*, its lighter shelled northern ally. Its favorite habitat is deep mud, in three to fifteen feet of water.

Purpurata is not a variable species, although being often attacked by parasites distortions of the shell frequently occur. It probably reaches its maximum size in Kansas waters. Call (4) gives the length of a number of large specimens from the Arkansas river and its tributaries. The length given is from 146 to 169.5 mm. A large male shell from the Blue river, in the Popenoe collection, at Manhattan, has a length of 192 mm. and a height of 121 mm. The only form with which this may be confused is *L. alata*, and the differences between these two species are noted under *L. alata*.

Lampsilis gracilis BARNES. Plate LXVII, fig. 4.

Unio gracilis Barnes, Amer. Jour. of Sci. and Arts, VI, 1823, p. 472.

Shell large, thin, widely elliptical, not inflated, alate, and sometimes bialate. Anterior margin projecting and rounded; ventral margin gently and evenly bowed; posterior margin rounded. Posterior margin winged in young specimens but generally about straight in old ones; anterior wing small and never present in old specimens. Umboidal ratio variable, 0.15 to 0.25. Umbones low and compressed, bearing several coarse, doubly looped ridges, but often worn smooth. Umboidal slopes flatly rounded, the posterior slightly excavated. Epidermis smooth and shiny or dull and cloth-like; color dark straw yellow, marked posteriorly with thin bands of dark green; where cloth-like, dull gray. Lines of growth numerous, continuous, crowded and imbricated posteriorly. Ligament long, fairly stout, dark brown.

Interior: Pseudocardinals weak, degenerate, thin and plate-like, single in each valve, sometimes mere nodules; laterals weak, short, thin, rather curved. Anterior adductor cicatrix lightly impressed, much longer than wide; anterior protractor cicatrix very wide and short, lightly impressed. Posterior cicatrices large, very slightly marked, confluent, wider than long. Pallial line slightly impressed anteriorly. Dorsal cicatrices prominent, about seven in number, arranged diagonally across the umbones. Cavity of the beaks slight, of the shell moderate. Nacre rose or salmon-pink umboidally, shading off into pearl; iridescent over greater part of the shell:

Length.	Height.	Breadth.	Um. ra.		
146	87	46	0.17	♂	(8.1)
120	70	38	.22	♂	(51.1)
121	67	39	.25	♀	(7.1)
103	60	36	.25	♀	(150.1)
106	60	33	.20	♀	(50.1)

L. gracilis has an extended range, being found from eastern Texas to the St. Lawrence, and east in the Hudson river. It is a common species in all river systems of Kansas. Its western range as reported in the Kansas drainage is the Solomon river, and the little Little Arkansas river in the southern drainage. It is often found in the Wakarusa and in

the Kansas river near Lawrence. Its habitat is mud and sand-bars, in deep water with little current.

The peculiar bialate character of this shell is lost in old specimens, but it is very striking in young specimens from favored localities. The most variable character is the degenerate pseudocardinals, which may be thin, erect, and knife-like, or else absent but for two pearly nodules. The only species with which this one may be confused is *L. lævissima*. *Lævissima*, however, is much thiner, has a darker nacre and epidermis, and the pseudocardinals are higher and directed obliquely.

Lampsilis lævissima LEA. Not figured.

Symphynota lævissima Lea, Trans. Amer. Phil. Soc., III, 1830, p. 444, pl. XIII, fig. 23.

Shell large, fragile, bialate, rather compressed, broad oval in outline. Anterior margin below the wing strongly curved; ventral margin strongly bowed; posterior margin rounded. Posterior wing high, thin, triangular; anterior wing low, triangular. Umboidal ratio, 0.25 to 0.35. Umbones low, pointed, marked with one or two fine concentric ridges, light gray in color. Anterior umboidal slope almost flat; other slopes quite flatly rounded. Epidermis smooth and shining, varying in color from gray horn to greenish yellow; young specimens almost covered with fine rays. Lines of growth fine, continuous, imbricated posteriorly, and in old specimens marginally, often indicated only by darker color across the disk.

Interior: Pseudocardinals thin, plate-like, rather high, triangular in elevation, set obliquely, single in the left and double in the right valve, the dorsal right being very minute. Laterals of moderate length, slightly curved, high, very thin. Anterior adductor cicatrix large, longer than wide, marked. Protractor cicatrix large, faint. Posterior scars large, very faint, confluent. Pallial line faint. Dorsal muscle scars large, faint, ill defined, arranged in a diagonal row across the cavity of the umbone. Lines of growth show plainly as rounded ridges on the inside of the shell. Nacre salmon to purple-pink and very iridescent.

Length.	Height.	Breadth.	Um. ra.	
131	85	42	0.36+	(328.1)
108	57	30	.26	(327.1)
83	47	26	.29+	(327.2)
183	100	.....	.27	(Coll. K. S. A. C.)

L. lævissima is distributed over the Mississippi drainage generally, and from western New York and southern Michigan to eastern Texas. In Kansas it is found in the Kansas river and many of its tributaries, as far west as the junction of the Solomon with the Smoky Hill river, in Dickinson county. It has also been reported from Fall river and the Arkansas in the southern drainage. Its habitat is mud or sand-banks, in quiet water of some depth. The delicate character of the shell and the hinge render it unfit for other conditions.

This is one of the thinnest of the *Unios*. The most striking character of the shell is the peculiar similarity of the pseudocardinals and laterals. When perfect, it is a beautiful shell. The differences from other closely allied forms has been noted under *L. alata* and *L. gracilis*. It is not a variable species.

Lampsilis leptodon RAFINESQUE. Not figured.

Unio leptodon Rafinesque, Ann. Gen. Sci. Phys. Brux., 1820, p. 295, pl. LXXX.

Symphynota tenuissima Lea, Trans. Amer. Phil. Soc., III, 1829, p. 453, pl. XI, fig. 21.

Shell small, thin, elongate ellipsoid, compressed, connate. Anterior margin an abrupt curve; ventral margin decidedly bowed; posterior margin elongately and roundly pointed; dorsal margin straight. Umboidal slopes very flatly rounded —in fact, almost straight. Umbones placed well forward (umboidal ratio, about 0.18). Umbones much flattened and very small. Epidermis smooth and shining, greenish straw-color, heavily radiate. Lines of growth dark and continuous, but few in number.

Interior: Pseudocardinals degenerate and hardly perceptible in the left valve; single, small, delicate and irregular in the right valve. Lateral teeth long, straight, extremely lamellar, sometimes single in both valves. Anterior adductor cicatrix well impressed, much longer than wide;

posterior scars faint and fused. Pallial line hardly outlined. Cavity of the shell slight; of the beaks, hardly present. Nacre bluish white, iridescent.

L. leptodon inhabits the streams of the northern Mississippi drainage and also occurs in Manitoba (Simpson). It has been found in Kansas only in the Neosho river (Call). It is the most delicate member of the genus and its outward form may confuse it with the anodons but laterals and pseudocardinals are present.

GENUS **OBOVARIA** RAFINESQUE, 1819.

"Shell short, oval, rounded or retuse, solid inflated, thick in front, thinner behind, with high beaks, which are sculptured with very faint, irregular, often broken, and slightly nodulous ridge, which shows a tendency to fall into two loops, the posterior often open behind; epidermis dull, brownish, silky or cloth-like, rarely rayed, rays indistinct; female shell but slightly inflated in the post-basal region, commonly having a shallow furrow or flattened area at the posterior end; pseudocardinals solid, stumpy; laterals short, club-shaped; anterior and posterior cicatrices deep and distinct; nacre bluish white or purple.

"Animal with very short gills, the inner united to the abdominal sac throughout, marsupium projecting far below the rest of the branchiæ and occupying the posterior portion of the outer gills, dolabriform or kidney-shaped; mantle with a wide, thickened, double-edged border, the inner edge of which is often slightly toothed at its post-basal part." (Simpson.)

Obovaria ellipsis LEA. Plate LXIX, fig. 2.

Unio ellipsis Lea, Trans. Amer. Phil. Soc., III, 1828, p. 268, pl. IV, fig. 4.

Unio pearlii Lea, Proc. Acad. Nat. Sci. Phila., I, 1874, p. 191.

Shell of moderate size, short, oval, quite heavy, particularly anteriorly, somewhat inflated. Anterior margin rounded; ventral margin decidedly bowed; posterior margin rounded or roundly pointed dorsally; dorsal margin rather curved, and meeting the posterior at a quite variable angle of from 130 to 160 degrees. Umboidal ratio generally small but very

variable; umbones full and swollen, decurved and ornamented with about seven slightly double-looped ridges. Anterior umboidal slope abruptly rounded; posterior slope gradually rounded but flattened somewhat near the posterior margin in the female. Epidermis smooth, often cloth-like, with occasional dark continuous lines of growth, in color from dark horn to honey-brown; young specimens a sage-green and marked with numerous narrow rays of dull green, which are often obscurely present in the adult shell. Ligament rather long, stout, chestnut brown.

Interior: Pseudocardinals heavy, very variable, generally high, erect, columnar or pyramidal, the posterior left often long and lamellar, double in the left and single in the right valve. Laterals of varying length and curvature, coarse and high. Anterior adductor cicatrix of moderate size, deeply excavated, set in front of the pseudocardinals. Posterior scars of moderate size, well impressed, often confluent. Pallial line generally impressed its entire length. Dorsal cicatrices numerous round pits in the cavity of the umbones. Cavity of beaks and shell moderate. Nacre white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
85	55	49	0.12	155°	♀	(21.1)
65	46	32	0.28	140°	♂	(155.1)
83	60	46	0.22	140°	♀	(156.1)
72	50	40	0.23+	144°	♂	(156.2)
42	35	23.5	0.30	148°	♀	(156.3)

O. ellipsis is found in the St. Lawrence drainage, and as far south as Tennessee and Arkansas in the Mississippi drainage. It has been found in all the drainage basins of the state, but it is most common in the Kansas river and its larger tributaries. It is here that, according to Call, it reaches its maximum development. I have seen shells having a length of three and three-fourths inches.

It is a lover of water of moderate depth and of sandy river-beds. Before the great floods of 1903–'04 it could be found in large numbers on the sand-bars near Lawrence. Its strong musculature and smooth shell enable it to move with comparative rapidity, and I have traced its furrow for fifty yards on sand-banks in the Kansas river.

The outline and the umboidal ratio of *ellipsis* are somewhat variable but otherwise it is an extremely constant species. The relation of the height to the length in adult shells averages about as 1 to 1⅓ and there is very little departure from this mean except in young shells, which vary somewhat. The longest shells are males, but the males as a class are no longer than females.

GENUS **PLAGIOLA** (RAFINESQUE, 1819) AGASSIZ.

"Shell triangular ovate, somewhat inflated, solid, with a distinct and often sharp posterior ridge; surface concentrically sculptured; umboidal area somewhat flattened; peaks high, sculptured with delicate, parallel, doubly looped ridges, the anterior rounded, the posterior angular; pseudocardinals ragged; laterals club-shaped, straight or slightly curved; cavity of the beaks moderate, often somewhat compressed; nacre silvery; female shells more or less inflated at the post-basal region.

"Animal with outer gills narrow in front, wide behind; inner gills wide in front, posteriorly free or united to the abdominal sac; marsupium occupying the posterior part of the outer gills, but not extending quite to the hinder end, consisting of well-marked ovisacs which are rounded below; a distinct sulcus extends the whole length of the kidney-shaped marsupium at the inside and outside at some distance above its base; mantle edge thickened and somewhat doubled, in some cases toothed or fringed below." (Simpson.)

Plagiola securis LEA. Plate LXIX, fig. 1.

Unio securis Lea, Trans. Amer. Phil. Soc., III, 1829, p. 437, pl. XI, fig. 17.

Unio lineolatus Conrad, New Fresh-water Shells, 1834, p. 70.

Shell of moderate size, thick, thickest dorso-anteriorly, roundly triangular in outline, much compressed, particularly in the umboidal region. Anterior margin flatly rounded; ventral margin gently bowed; posterior and dorsal margin one gentle and continuous curve. Umboidal ratio, approximately 0.19. Umbones much flattened, pointed, incurved. Anterior umboidal slope flatly rounded; lateral slope almost flat; umboidal ridge sharp and continuous; pos-

terior slope sharply truncated, often at right angles to the lateral slope dorsally. Shell concentrically sculptured with smooth, continuous ridges, which are much crowded on the posterior slope. Epidermis from horn color to deep chestnut brown, and more or less marked with a series of curved rays, rays, which are made up of a series of widely separated dark dots. Ligament short, thick, dark brown.

Interior: Pseudocardinals double in the left and single in right valve, erect, large, pyramidal, coarsely serrate. Laterals of moderate length, curved or almost straight, oblique, heavy, tending to be double in both valves. Interdentum large and smooth, but cut away back of the right pseudocardinal. Muscle cicatrices of moderate size, the two adductor scars of about equal size and excavation. Pallial line well impressed, often its entire length. Dorsal cicatrices a line of pits in the wall of the umbone cavity. Cavity of the umbones moderately large, of the shell slight, that of the female greater than that of the male shell. Nacre milk white, very slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.		
82	53	23	0.20	♂	(147.2)
105	65	42	.19	♂	(36.1)
71	57	34	.18+	♀	(36.2)
76	53	20	.20+	♂	(147.1)

This species is distributed generally over the Mississippi drainage as far south as Louisiana, and is also found in the Tombigbee and Alabama river systems. Its distribution in Kansas is limited to the clear-water rivers of the southern drainage. The exact localities from which it has been reported are: Spring river, Baxer Springs (Cragin); Fall river, Wilson county (Mead and Popenoe); Neosho river, at Oswego (Newlon), and at Burlington and the southern state line. At the last locality it is quite common in the rocky riffles. The species is not confined to riffles, however, but occurs in a variety of locations.

This form shows a decided variation, which is dependent directly on its habitat. In localities where rocks abound and the current is swift the animal develops a strong musculature and a stout, heavy shell. Slow-flowing streams with muddy beds cause the animal to develop a long, light, greatly com-

pressed shell, with a comparatively weak musculature. A comparison of forms from these two different habitats in the same stream are given below:

	Specimens from Neosho river at state line. A	Specimens from Neosho river at Burlington. B
Thickness of shell	Very thick	Moderately thick.
Color of epidermis	Dark chestnut	Horn color.
Rays.	Distinct.	Indistinct.
Ratio of height to length	0.60	0.60 to 0.70
Ratio of breadth to length*	Approx. .20	Approx. .40

*This ratio is taken from male shells in both cases.

A complete series of gradations may be found between these two extremes. The dimorphism of this form is indicated by the somewhat greater inflation of the female. There is no other Kansas *Unio* with which this can easily be confused.

Plagiola elegans LEA. Plate LXX, fig. 3.

Unio elegans Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 83, pl. IX, fig. 13.
Unio truncatis Say, Amer. Conch., VI, 1834.

Shell rather small, somewhat thickened anteriorly, thin posteriorly, trigonal, inflated. Anterior margin curved; ventral margin curved, often somewhat emarginate the posterior third; posterior margin pointed, sometimes straight and joining the dorsal margin at a wide angle and sometimes forming a continuous gentle curve with it; dorsal margin short, straight or gently curved oblique. Umboidal ratio, 0.25 to 0.30. Umbones full, elevated, slightly incurved, marked in some cases with a few faint concentric ridges. Anterior umboidal slope fully rounded; lateral slope fully rounded anteriorly and marked by a broad furrow in some cases; posterior umboidal ridge sharp, well defined, and continuous from umbones to margin; posterior slope slightly incurved. Color of the epidermis from grass-green to dark brown, often rayed; rays thin, thread-like, sometimes wavy, crowded. Lines of growth fairly continuous, even, rarely imbricated. Ligament short, dark brown.

Interior: Pseudocardinals erect, very high and sharp

pointed, ragged, double in the left and single in the right valve. Laterals rather long, thin, curved. Anterior adductor cicatrix an elongated quadrant, well impressed dorso-posteriorly; posterior cicatrices large, lightly impressed, confluent. Dorsal scars rather large pits in the cavity of the umbones. Pallial line well impressed anteriorly. Cavity of beaks and of the shell considerable. Nacre white, quite iridescent.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
54	39	26	0.25	145°	(39.1)
50.5	38	25.5	.30+	149°	(39.2)
44	31	19.5	.28+	152°	(38.1)
46	31	21	.29+	147°	(39.3)
37	24	16	.27	147°	(38.2)

This beautiful little *Unio* has a general range coextensive with that of the preceding member of this genus. Its range in Kansas, however, far exceeds that of *P. securis*, for it is common to all the drainage systems of the state. It has been reported as far west as Wildcat creek, Riley county (Popenoe) in the Kansas drainage, and is found as far west as the Little Arkansas in the southern drainage (Call). Its habitat is the muddy or sandy beds of streams of some size. In my collecting I have never found this form abundant, although present in all good-sized streams. It is often found in the Wakarusa and sometimes in the Kansas river at Lawrence.

The variability of this form is slight and is confined mainly to the color and character of the epidermis. The umboidal ridge is much more prominent in young than in old shells. Its nearest relation, *P. donaciformis*, can be easily identified from *elegans* by the greater length and the finer pseudocardinals of the former. The relation of the height to the length of the shell in *elegans* averages 1 : 1.3. The same relation in *donaciformis* is 1 : 1.8. *P. elegans* can easily be separated from the young of the trigonal *Quadrulas* by its thinner shell and sharp, erect teeth.

Plagiola donaciformis Lea. Plate LXX, figs. 1, 2.

Unio donaciformis Lea, Trans. Amer. Phil. Soc., III, 1827, p. 267, pl. IV, fig. 3.

Unio zig-zag Lea, Trans. Amer. Phil. Soc., III, 1829, p. 440, pl. XII, fig. 19.

Shell small, moderate in thickness, elongate ellipsoid,

neither compressed nor inflated. Anterior margin variably curved; ventral margin decidedly bowed; posterior margin roundly or sharply pointed; dorsal margin straight, slightly oblique, and meeting the upper part of the posterior margin at an angle of 150 degrees. Umboidal ratio, 0.30. Umbones rather full, not high, curved inward and downward, with numerous fine concentric ridges, which are sometimes double-looped. Anterior umboidal slope rather flatly rounded; posterior slope sharp near the umbones, but rounded ventrally, slightly excavated. Epidermis smooth, sometimes shiny, marked with numerous fine, fairly continuous lines of growth, in color variable; type A, dirty brown with a greenish cast, marked with numerous dark rays more or less green, conspicuous; type B, light horn, with brown rays made up of V-shaped dashes of dark color directed ventrally; all variations occur between these two; color over umbones generally a lighter shade. Ligament short, thick, dark brown.

Interior: Pseudocardinals double in the left and single in the right valve, high, thin, pointed, the left posterior decidedly curved dorsally. Laterals straight, long, directed ventrally, the dorsal lateral in the left valve often degenerate. Anterior adductor cicatrix much longer than wide, well excavated dorsally; posterior cicatrices small, lightly rarely confluent. Pallial line slightly impressed anteriorly. Dorsal muscle scars often large, in the cavity of the beaks. Cavity of beaks deep, of shell moderate. Nacre white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
63	33	22	0.28	144°	♀	(400.1)
45	22	18	.30	155°	♂	(401.1)
52	30	21.5	.30	150°	♂	(400.2)
38	25	15	.32	157°	♀	(402.1)

P. donaciformis ranges from Michigan south to the Alabama river and to Trinity river, Texas. It is common to all the Kansas drainage systems and abundant in all of them. It does not frequent the smaller streams but seems to be confined to the sandy and muddy beds of rivers. Formerly it was quite common in the eastern portion of the Kansas river.

As a rule there is little variability in either the outline or inflation of this species, but the coloration of the epidermis is subject to great variations. The ground shade may be either light straw, brown, olive-gray, or almost black. The rays when present may be either solid or made up of numerous small V-shaped dark spots, which have given to this form the name of *Unio zig-zag*. All gradations may be found between these different types.

GENUS **TRITOGONIA** AGASSIZ, 1852.

"Shell solid, elongate rhomboid, having a strong irregular posterior ridge, obliquely truncated behind in the male; in the female this region is somewhat compressed and rounded; base incurved; whole surface except rounded wing of the females covered with pustules; beaks low, incurved, and turned forward over the well-developed lunule, which is elongate and filled with epidermal matter; beak sculpture strong, consisting of irregular subparallel ridges which are curved up behind, and fine radiating ridges in front and behind this; epidermis dark olive; hinge plate rather narrow, pseudocardinals strong, ragged; laterals long and straight, near to the pseudocardinals; adductor scars shallow; cavity of the beaks rather deep and compressed; female shell more compressed than that of the male.

"Animal with inner gills much larger than the outer, generally free for the most part from the abdominal sac; palpi enormous, elongate, united to each other behind, and to the mantle a part of their length; mantle thin, with a thickened, dark double border, the inner edge often toothed throughout, the base much thickened at the posterior end and folded at the branchial opening; branchial opening large, with numerous crowded papillæ; anal opening smooth or with only fine dentations; superanal opening long, closed below; in the female there is a thickened flap of the mantle which fills the circular posterior expansion of the shell, and which has a smaller flap inside; foot and abdominal sac large, the latter winged in front." (Simpson.)

Tritogonia tuberculata BARNES. Plate LXX, fig. 4.

Unio tuberculatus Barnes, Amer. Jour. Sci. and Arts, VI, 1823, p. 125, pl. VII, figs. 8*a*, 8*b*.

Unio verricosus Say, Amer. Conch., VI, 1834.

Shell large, solid, elongate, and irregularly trapezoidal. Anterior margin and front third of the ventral margin a gentle curve, middle third of the ventral margin incurved, posterior third of the ventral margin straight or curved somewhat upward; posterior margin somewhat oblique and rounded, straight in males and greatly produced in females; dorsal margin straight or slightly curved and meeting posterior margin at a variable angle. Umboidal ratio variable, from 0.15 to 0.25 Umbones sharp, low, incurved, marked with a number of acute tubercles, which posteriorly form fine lines in some cases. Anterior umboidal slope flatly rounded, lateral slope slightly excavated, both thickly studded with small, low tubercles, which often arrange themselves into diagonal rows. Posterior umboidal ridge very prominent, slightly curved posteriorly; in the males numerous side ridges are given off which run to the posterior margin; this character not well developed in females; posterior slope of male short and truncate, of female developed ventrally into a long, smooth wing. Epidermis from rusty chestnut brown to dark horn color, with sometimes a greenish tinge. Lines of growth coarse, but not continuous. Ligament long, dark brown. Lunule large, black.

Interior: Pseudocardinals large, pyramidal, ragged, double in the left, single and sometimes double in the right. Laterals long, straight, rather heavy. Anterior adductor cicatrix deep, and sometimes set slightly under the anterior pseudocardinal; retractor cicatrix small and well impressed. Posterior scars well marked, of moderate size, fused. Dorsal cicatrices small. Pallial line impressed and crenulate anteriorly. Cavity of beaks deep, of the shell moderate. Nacre milk-white, iridescent posteriorly.

Length.	Height.	Bredth.	Um. ra.		
168	81	47	0.19	♀	(215.1)
159	74	39	.17+	♀	(215.2)
118.5	67	33.5	.23+	♂	(28.1)
118	63	34	.19—	♂	(37.1)
123	60	32	.16+	♀	(37.2)

T. tuberculata is found throughout the Mississippi drainage and in those streams emptying into the Gulf from Alabama to Texas. Its distribution in Kansas is general. Its reported western range in the southern drainage is the Little Arkansas river at Wichita (Mead). In the Kansas drainage it has been found as far west as the Smoky Hill river at Salina. It doubtless ranges somewhat further westward. The largest specimens I have seen from Kansas waters were two females from the latter locality. Their measurements are given in the table above (215.1 and 215.2).

There seems to be no definite habitat for this species. It is found in almost all locations except sandy, shifting river-beds. In the Wakarusa river at Lawrence, where it is a common species, it is found well rooted in the gravel and shingle in a swift current, and again buried to the siphons in the thick black mud, where there is but little current, in company with *Symphynota complanata* and *Strophitus edentulus*. I have found specimens in Indian creek, in Johnson county, lying on a hard rock bottom in six inches of rapidly flowing water.

This is one of the easiest species in which to distinguish the sexes. The males are short, thick, and abruptly truncate posteriorly; the females long, slender, and provided with the posterior wing. There is great variation in the number and position of the pustules. This is one of the easiest of Kansas *Unios* to identify.

MESOGENÆ.

"Male and female shells alike, short, solid, inflated, embryo occupying a few distinct ovisacs in the center of the outer gills." (Simpson.)

Genus **CYPROGENIA** Agassiz, 1852.

"Shell solid, inflated, rounded triangular, sometimes slightly retuse, generally a little biangulate behind; posterior ridge unusually well developed, especially in the young shell; umboidal region flattened parallel with the axis of the shell, sometimes compressed; beaks turned inward and forward, the sculpture very faint, consisting of slightly doubly looped ridges; sculpture of the shell nodular, radially wrinkled or

lachrymose; ligament black and conspicuous; lunule distinct and well developed; epidermis shining, painted with a delicate dark mottling on a light ground; hinge plate wide and flat; pseudocardinals heavy, triangular, blunt, ragged; laterals short, obliquely striated; cavity of beaks not deep; adductor scars small, well impressed, those at the posterior round; nacre bright and silvery.

"Animal with inner gills partly free from the abdominal sac, rounded below outer gills, smaller marsupium consisting of from seven to twenty-three very long purple ovisacs pendant from the central base of the outer gills and formed into a close coil with the ends turned inwardly; branchial opening large, with many small papillæ; anal opening smooth." (Simpson.)

Cyprogenia alberti CONRAD. Plate LXXI, fig. 2.

Unio alberti Conrad, Proc. Acad. Nat. Sci. Phila., 1854, p. 295, pl. XXXVI, fig. 1.

Unio lamarcianus Lea, Trans. Amer. Phil. Soc., X, 1852, p. 236, pl. XVII, fig. 20.

Unio popenoi Call, Bull. Washb. Coll., I, 1885, p. 48, pl. II.

Shell moderately large, very roundly triangular, compressed, solid, thickest anteriorly. Anterior margin irregularly rounded; posterior margin gently curved, emarginate posteriorly; posterior margin short, slightly emarginate centrally; dorsal margin long, oblique, curved. Umboidal ratio, 0.20 to 0.40. Umbones triangular, flat but fairly high, pointed, plainly marked with the high but rounded umboidal ridge, directed slightly forward. Anterior umboidal slope fully rounded, lateral slope bearing a shallow but distinct furrow; posterior umboidal ridge high, distinct, spreading out ventrally and rounded on both sides; posterior slope slightly excavated; the umboidal third of the shell much compressed. Shell sculpture consisting of several rounded, concentric ridges toward the center of the disk and a series of fine diagonal furrows above them in the lateral furrow. Epidermis straw yellow with wide, dark rays of green, which are curved forward, the spaces between the rays dotted with minute triangular dots of green, which arrange themselves at times into fine lines. Ligament long, thin, dark brown.

Interior: Pseudocardinals fairly large, erect, pointed, ragged, double in the left and single in the right valve. Laterals short, low, heavy, straight, very oblique; interdentum long, broad, and smooth. Anterior adductor cicatrix rather small, located in front of the pseudocardinals, much longer than wide, well excavated. Posterior cicatrices small, well impressed, distinct. Dorsal cicatrices forming a line on the under surface of the interdentum. Pallial line impressed only anteriorly. Hardly any beak cavity; cavity of the shell small. Nacre a beautiful white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
74	64	37	0.36	(Coll. K. S. A. C.)
76	64	36	.21	(Coll. Kan. Acd. Sci.)
61	53	30	.30	
77	62	40	.25	
65	51	24	.31	

C. alberti is limited in range to southern Kansas, Missouri, Indian Territory, and Arkansas. Its distribution in Kansas is limited to the clear-water streams of the southern drainage. The streams in which it has been found are Fall river (Mead, Popenoe), Verdigris river (Cragin, Popenoe), and Neosho river (Fenis). Even in these streams it is a rare species.

As compared with specimens before me from the White river, Arkansas, the Kansas form is a much larger, more inflated and massive shell, with smaller muscle cicatrices. Doctor Call described specimens from the Neosho and Verdigris rivers as a new species (*Unio popenoi*), but later on worked out the synonomy and placed it under *U. alberti* (5–6).

There is no other *Unio* in Kansas which can be confused with this one. The peculiar markings of the epidermis and the extreme flattening of the beaks for about one-third the distance vertically across the disk is very characteristic.

GENUS **OBLIQUARIA** (RAFINESQUE, 1820) SIMPSON.

"Shell inflated, solid, oval, ending in tolerably sharp point behind, having a row of large compressed longitudinal knobs running off from the beaks to the center of the base, those on one valve alternating in position with the knobs of the

other, and a well-developed posterior ridge, the space between the ridge and the knobs somewhat excavated; posterior slope and sometimes the whole shell more or less corrugately sculptured; beaks prominent, incurved, and pointed slightly forward towards a tolerably well-developed lunule; beak sculpture strong, consisting of four or five heavy, parallel ridges, which fall low in front but are curved up behind; epidermis smooth, generally shining, painted with numerous delicate, wavy, darker, broken rays; pseudocardinals strong, direct, and ragged; laterals short, nearly straight; anterior muscle scars small, sides of the pit smooth, bottom ragged; front part of shell very solid, suddenly becoming rather thin just behind the knobs; male and female shells essentially alike.

'Animal with small branchiæ, rounded below, inner the larger, free from the abdominal sac in part; marsupium of a few distinctly marked ovisacs (4 to 7), occupying a position just behind the center of the outer gills, projecting far below the rest of the branchiæ, their bases rounded; mantle cut away at the thinner portion of the shell; anal opening smooth or having only minute crenulations.'' (Simpson.)

Obliquaria reflexa RAFINESQUE. Plate LXXI, fig. 1.

Obliquaria reflexa Rafinesque, Ann. Gen. Sci. Phys., 1820, p. 306.

Unio cornutus Barnes, Amer. Jour. Sci. and Arts, VI, 1823, p. 122, pl. IV, figs. 5, 5*a*, 5*b*, 5*c*.

Shell rather small, inflated, thick anteriorly, of only moderate thickness posteriorly, outline variable, wide or narrow, ovate, pointed posteriorly. Anterior margin and anterior half of ventral margin forming a semicircular curve, posterior position of ventral margin curved or straight, sometimes slightly emarginate; posterior margin short, commonly joining the dorsal margin at an angle of from 130 to 145 degrees but sometimes forming a common curve with it. Umboidal ratio, one-fourth to one-third. Umbones large and full, incurved, marked with several heavy ridges. Anterior umboidal slope fully rounded; lateral slope ornamented with a series (generally four) of large, prominent knobs, which are located in a slightly curved line and are about twice their diameter apart, the area between them slightly excavated; knobs alter-

nating with each other on the opposite valves; posterior to the knobs a very shallow furrow is generally present. Umboidal ridge permanent, continuous, rounded; posterior slope slightly excavated, ornamented with small, obscure, transverse ridges. Epidermis smooth; in color brown, color sometimes arranged in concentric bands of lighter and darker shades, frequently rayed with obscure, narrow, wavy lines of dark green. Lines of growth rounded and continuous, often dark colored. Ligament short, thick, dark brown; lunule small but well marked.

Interior: Pseudocardinals large, ragged, pyramidal, double in the left and single in the right valve, the right tooth surrounded by a trench in which the left pseudocardinals lock. Laterals low, thick, short, slightly curved. Anterior adductor cicatrix small, well excavated, long and narrow, the floor roughened; posterior scars rather small, well impressed, distinct. Pallial line impressed for anterior half. Dorsal cicatrices forming a line on the base of the pseudocardinals. Cavity of beaks variable, generally small, of the shell small. Nacre silver white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	Number of nodules.	
56	50	32	0.30	132°	4–5	(23.1)
48	34.5	23.5	.30	131°	4–4	(34.1)
62	49	36.5	.27+	Curved.	4–4	(22.1)
58	45	27.5	.29	144°	4–3	(22.4)
42.5	29	18	.26+	Curved.	3–	(326.1)

This species ranges from Michigan south and southwest to Alabama and central Texas. In Kansas it is found in the clear-water rivers of the southern drainage and in them is an occasional but not a common species. Only one specimen has been found in the Marais des Cygnes drainage. This was a single valve from the Marais des Cygnes at Ottawa. Cragin similarly reports a single specimen from the Kansas drainage, found at Mill creek, in Wabaunsee county. The favorite habitat is gravel-beds. No species is more distinct than this one. It can be distinguished from any other Kansas *Unio* without difficulty by the prominent lateral knobs alone. There is comparatively little variation.

PTYCHOGENÆ.

"Male and female shells essentially alike; embryos contained in distinct ovisacs with rounded bases, occupying the entire outer gills, which, when gravid, consist of a series of folds." (Simpson.)

GENUS **PTYCHOBRANCHUS** SIMPSON, 1900.

"Shell triangular, solid, sometimes becoming arcuate in old specimens; umboidal region rather elevated; beak sculpture consisting of faint, somewhat broken ridges, which have a tendency to be doubly looped; posterior ridge round but well developed; epidermis usually painted with wavy hair-line rays or broken radiating bars, which show a tendency to form square spots; hinge plate rather wide and flat; pseudocardinals small, low, triangular, and roughened; laterals club-shaped, remote; cavity of the beaks shallow; muscle scars rather deep.

"Animal with inner gills free all or part of their length from the abdominal sac; marsupium occupying the basal half of the whole length of the outer gills and hanging in from six to twenty beautiful folds; ovisacs distinct, each ending below in an enlarged, rounded bulb with a colored spot in its center; mantle thin, with a dark, thickened border; branchial opening large, with very minute papillæ or crenulations, sometimes smooth; anal opening crenulate or smooth." (Simpson.)

Ptychobranchus phaseolus HILDRETH. Plate LXXII, fig. 2.

Unio phaseolus Hildreth, Amer. Jour. Sci. and Arts, XIV, 1828, p. 283.
Unio planulatus Lea, Trans. Amer. Phil Soc., III, 1830, p. 431, pl. IX, fig. 13.
Unio camelus Lea, Trans. Amer. Phil. Soc., V, 1834, p. 102, pl. XV, fig. 45.

Shell of moderate to large size, compressed, elongate ellipsoid in the outline, very heavy. Anterior margin very decidedly rounded; ventral margin gently bowed or straight; posterior margin roundly pointed, the point being directed ventrally; dorsal margin oblique and curved, generally passing gradually into the posterior margin. Umboidal ratio, about 0.25. Umbones low and compressed, marked with a number

of very fine undulating ridges. Umboidal slopes flattened dorsally but decidedly curved marginally. Posterior umboidal ridge prominent but rounded. Epidermis light horn color (often with an olive-green cast) to dark chestnut-brown. Rays either fine, dark, and wavy, or broad and interrupted. Lines of growth numerous, coarse, and often imbricated. Lunule large and elongate. Ligament short and stout.

Interior: Pseudocardinals small, low, serrate, bluntly pyramidal, single in the right and double in the left valve. Laterals short, heavy, slightly curved, oblique. Interdentum quite long, smooth, broad. Anterior adductor cicatrix deeply pitted, elongate, placed in front of the pseudocardinals. Posterior scars deeply impresssd and distinct, the retractor almost hidden, and placed in on the tip of the lateral tooth; adductor scar elongate and pointed posteriorly. Dorsal muscle scar large and well impressed on the lower surface of the interdentum. Pallial line impressed its entire length. Branchial area well impressed, cavity of shell small. Beaks practically without a cavity. Nacre milk-white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
79	42	25	0.28	(311.2)
98	55	34	.23	(350.1)
82	45	34	.23	(311.1)
87	46	29	.20	(311.3)

The range of this species is throughout the southern portion of the Mississippi valley, the Ohio river drainage, and the peninsula of Michigan. In Kansas it is found quite commonly in the clear-water rivers of the southern drainage, particularly in the smaller streams. One specimen has been reported by Call from the Wakarusa river, but careful collecting along that stream at intervals during the last five years has failed to bring to light any more specimens. In the southern rivers of the state the shell reaches unusual size, some specimens in the State Agricultural College, collected by Professor Popenoe, have a length of over 110 mm.

This form varies much in shape, and often presents a humped appearance, which has led to its description as a separate species. There are, however, all gradations between this form and the typical one. This species may be confused

with *P. clintonense* (given below) and with *Unio gibbosus*. The beak sculpture of the form under discussion consists of numerous fine ridges, while the umbone ridges of *U. gibbosus* are few and extremely coarse. However, owing to the peculiarly soft character of the shell substance, the beaks of *phaseolus* are almost always much worn. The epidermis of *phaseolus* is lighter and more cloth-like in texture than that of *gibbosus*, and the adult *gibbosus* is eradiate. The lateral teeth of *gibbosus* are longer than those of *phaseolus*.

Ptychobranchus clintonense SIMPSON. Not figured.

Ptychobranchus clintonensis Simpson, Proc. Acad. Nat. Sci. Phila., 1900, pt. 1, p. 79, pl. 5, fig. 3.

"Shell elongate, elliptical, sometimes slightly obovate, feebly biangulate behind, quite solid, beak sculpture not seen; epidermis somewhat cloth-like, dirty olive, the hinder two-thirds of the shell ornamented with delicate, wavy, capillary rays; pseudocardinals low, laterals very heavy, remote; muscle scars large and well defined; nacre lurid, with greenish-brown blotches. Length, 73; height, 40; breadth, 22." (Simpson.)

This species is described by Simpson from the Little Red river near Clinton, Ark. I have a number of specimens from Spring river at Baxter Springs which will probably fall under this species, but until there is more material in better condition at hand for identification I list this species for the state as doubtful. It is quite close to the preceding one.

DIAGENÆ.

"Male and female shells alike; embryos contained in the outer gills in short ovisacs, which run crosswise of the branchiæ, and are discharged entire into the water." (Simpson.)

GENUS **STROPHITUS** RAFINESQUE, 1820.

"Shell elliptical to rhomboid, inflated, subsolid, pointed or biangulate behind, with a low posterior ridge which is sometimes double; beaks full, sculpture consisting of a few strong concentric ridges which curve sharply upward behind; epidermis rayed or rayless, shining; hinge line incurved in front of the beaks; teeth rudimentary, a vestigeal, compressed

tooth in each valve, and sometimes a secondary tooth ; laterals rarely present ; muscle scars shallow.

"Animal with the marsupium occupying the whole of the outer gills, consisting of short, horizontal ovisacs, which run directly across the gills, and are discharged through the outer wall with the ovules in them ; ovules ten to twenty-five in each ovisac and arranged in one or two rows, inner gills the larger, free in part from the abdominal sac, or wholly united ; mantle generally bordered behind with square black spots ; branchial opening with numerous papillæ ; opening papillose or crenulate." (Simpson.)

Strophitus edentulus SAY. Plate LXXII, fig. 1.

Alasmodonta edentula Say, New Harm. Diss., II, No. 22, 1829, p. 340.

Anodonta wardiana Lea, Trans. Amer. Phil. Soc., IV, 1836, p. 46, pl. XIV, fig. 42.

Anodonta arkansasensis Lea, Trans. Amer. Phil. Soc., XI, 1852, p. 293, pl. XXIX, fig. 56.

Shell moderate to large, rather thin, but variable in this respect, slightly thickened anteriorly, long elliptical, not much inflated. Anterior margin rounded ; ventral margin somewhat bowed ; posterior margin roundly triangulate, the point of juncture of the two posterior margins being exceedingly variable in its position ; dorsal margin straight, and joined with the posterior at a very greatly varying angle. Umboidal ratio approximately one-third of the entire length, and quite constant. Umbones fairly prominent, but not much raised, and ornamented with three or four coarse ridges. Lines of growth quite continuous and very variable in their prominence. Color of epidermis varies from light horn to almost black ; young specimens marked with dark green rays, old shells eradiate. Ligament stout, almost black.

Interior : Pseudocardinals represented by one or two pearly nodules below or anterior to the umbones, hinge ridge rather heavy. Anterior muscle scars well marked ; anterior adductor cicatrix sometimes slightly impressed ; posterior scars small but well marked, often fused. Pallial line hardly apparent ; prominent lines of growth show on interior surface as slight rounded ridges. Cavity of shell moderately deep,

of umbones shallow. Nacre variable, sometimes silver-white; cavity of the shell often salmon-yellow, varying to salmon-rose; posterior and lower margins of the shell iridescent.

Length.	Height.	Breadth.	Um. ra.	
100	58	34	0.33	(161.1)
62	43	27.5	.37	(160.1)
81	44	30	.33	(160.2)
56	29	18	.35+	(160.3)
67.5	35	23	.33	(160.4)

This species is found throughout the Mississippi and St. Lawrence drainage areas and in eastern Texas. In Kansas it is common to all the drainage basins. It has been reported as far west as Reno county (Mead) in the southern drainage, and as the Smoky Hill river at Salina in the western drainage. In the streams and small rivers of the east central part of the state it is quite abundant. Although preferring a muddy bottom and quiet water, it is able, by anchoring itself in the silt with its muscular foot, to withstand a strong current. It is a rapid burrower and quite tenacious of life.

There is but little variation in this form while it remains in quiet, muddy streams, but rapid flowing and rocky streams produce a variety of forms and colors in the shell, any of which would be sufficient to characterize a species were they constant.

The peculiar rudiments of pseudocardinals will serve to separate this species from any other in the state.

HOMOGENÆ.

"Male and female shells alike, oval to elongate; beak sculpture coarse; embryos filling the entire gills in the form of thick, smooth pads; the ovisacs not separated by sulci." (Simpson.)

Genus **ANODONTA** Lamarck, 1799.

"Shell elliptical, thin, inflated, often slightly winged posteriorly; beak sculpture consisting of rather numerous more or less parallel ridges, usually somewhat doubly looped, and becoming slightly nodulous on the loops; surface generally smooth, shining; hinge edentulous, reduced to a mere line, regularly curved; muscle scars rather faint; nacre dull.

"Animal with the marsupium occupying the whole outer gills, when filled forming a smooth, very thick, liver-colored pad; gills free from the abdominal sac from one-half to their entire length; palpi generally large; branchial opening papillose; anal opening without papillæ, though sometimes very slightly crenulate; superanal opening generally small, widely separated from the anal." (Simpson.)

Anodonta imbecillis SAY. Plate LXXIV, fig. 1.
Anodonta imbecillis Say, New Harm. Diss., II, No. 23, 1829, p. 355.
Anodonta incerta Lea, Trans. Amer. Phil. Soc., V, 1834, p. 46, pl. VI, fig. 16.

Shell moderate in size, very thin, elliptical, inflated. Anterior margin rounded; ventral margin bowed, sometimes slightly produced posteriorly; posterior margin roundly pointed, point variable in length and sometimes turned slightly upward; dorsal margin straight, variable in length, dorsal posterior angle from 145 to 150 degrees. There is a tendency to form a dorsal wing. Umboidal ratio, approximately 0.30; umbones extremely small and flat, marked by several fine broken ridges concentrically arranged. Anterior and lateral slopes rounded; posterior slope somewhat excavated. Lines of growth continuous, dark in color, infrequent. Epidermis smooth and polished, bottle-green to pea-green in color, the umbones a light horn-brown; postumboidal slope often dark brown, disk often marked with dark green rays. Ligament slight, long.

Interior: Muscle scars slightly marked, anterior ones the more so; pallial line sometimes marked. Cavity of shell large of beaks practically none. Nacre silver-white, iridescent over the entire cavity.

Length.	Height.	Breadth.	Dorsal posterior angle.	Um. ra.	
74	34	27.5	153°	0.30	(33.1)
77	36	30	154°	.31	(33.3)
53	26	19	145°	.30	(31.1)
63	31	24.5	145°	.29+	(33.4)
62.5	26.5	24	151°	.29	(33.6)

A. imbecillis has a general distribution in all the Mississippi valley, Texas, North and South Carolina. It is found in all the Kansas drainage areas and is plentiful in favored stations in all of them. It is reported by Call as far west as Reno

county in the southern drainage area, and I have received specimens from as far west as Hays, from Big creek, a tributary of the Smoky Hill river, in the Kansas drainage. The largest specimens that I have seen from the state were from Rock creek, Douglas county. This species is a lover of quiet water and muddy or somewhat sandy banks. It is in fact unfitted to survive other conditions on account of its fragile shell.

There is no species with which this form can be easily confused; the extreme fragileness of the shell and lack of umbones will distinguish it from the young of *A. grandis*. It varies but little.

Anodonta suborbiculata SAY. Plate LXXIII.

Anodonta suborbiculata Say, New Harm. Diss. (newspaper form), Jan. 29, 1831.

Shell very large, thin, slightly compressed, suborbiculate in outline. Anterior margin flatly curved; ventral margin almost circular; posterior margin rounded for the first fifth ventrally, and very slightly incurved for the remaining four-fifths; dorsal margin straight or very slightly curved. Umboidal ratio variable, from 0.25 to 0.40. Umbones very low and flat, and ornamented with four or five pairs of slight nodules arranged in a series which represent degenerate double-looped ridges. Anterior and lateral umboidal slopes flatly curved; posterior umboidal ridge low but distinct; posterior slope slightly excavated. Epidermis straw-yellow to dark brown in color, smooth and shining except for the posterior umboidal slope, which is slightly roughened; fine green rays are sometimes present. Lines of growth fine and continuous. Ligament dark and rather stout.

Interior: Hinge line very thin. Muscle scars large, very faint. Pallial line very faint. Cavity of shell rather large, of beaks very slight. Nacre white, varying to a light salmon, deepest in color near the umbones, very iridescent.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
176	133	58	0.26+	140°	(Coll. Kan. Acad. Sci.)
135	98	44	.40	125°	
72	58	18	.32	110°	(Coll. W. C.)

This species extends from Nebraska and Illinois south to

Louisiana (Simpson). It is generally a rare species, but sometimes abundant locally (Call). It has been reported from only two localities in the state, the Neosho river in the southern drainage (Call), and Silver Lake, Shawnee county, in the Kansas drainage. Its habitat is the muddy beds of slow streams and ponds.

This is the largest anodon found in the state. The largest specimen I have seen from the state measured 176 mm. in length. It is in the Quintard collection of the Kansas Academy of Science, at Topeka. There is but little variation. The juvenile shells are much more rayed than are the adult, and the dorsal posterior angle grows less acute as the shell increases in size and age.

Anodonta grandis SAY. Plate LXXIV, fig. 3.

Anodonta grandis Say, New Harm. Diss., II, 1829, p. 341.
Anodonta ovata Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 2, pl. II, fig. 2.
Anodonta salmonia Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 45, pl. XIV, fig. 41.
Anodonta lewisii Lea, Proc. Acad. Nat. Sci. Phila., I, 1857, p. 84.

Shell large, moderately thin, inflated, wide elliptical. Anterior margin rounded; ventral margin generally gently bowed but sometimes almost straight; posterior margin bluntly angulate or rounded; dorsal margin straight or slightly curved and extremely variable in its length, the dorsal posterior angle quite variable. Umboidal ratio quite constant, at approximately one third. Umbones more or less inflated and marked with three or four coarse double-looped ridges. Umboidal slopes rounded, the posterior and anterior slope flattened near their margins. Epidermis smooth, shining, variable in color, generally green over the disk and brownish gray on the umbones, and the posterior slope almost black, the color often arranged in concentric bands of different shades; large old specimens are often black, young specimens obscurely rayed. Ligament moderately long, stout, very dark brown. Posterior hinge line slightly curved and well defined. Muscle cicatrices large, rather faintly outlined. Pallial line not visible in some specimens and never impressed. Dorsal muscle scars occasionally impressed, but often faint, located in the wall of the tip of the umbone cavity. Umboidal cavity small, cavity of shell large.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
124	72	46	0.30	156°	(27.1)
135	77	49	.28+	Rounded.	(56.1)
122	70	38	.32	154°	(25.1)
103	57	37	.31	151°	(57.1)
97	55	31	.31+	146°	(26.1)

A. grandis and its varieties range from the upper St. Lawrence and Lake Winnipeg southwest through the Mississippi drainage to Texas. It is our commonest and one of our largest anodons, and is well distributed over all the Kansas drainage areas. Its favorite habitat is the muddy beds of permanent ponds and lakes and slow-flowing streams. Sometimes, however, the species becomes established in large, rapidly flowing, but not rocky streams. It is abundant in the lakes formed from old river-beds of the Missouri river along the northern part of the east boundary of the state, but it is not present in similar bodies of water along the Kansas river near Lawrence.

This is one of the most variable of Anodons, and is possessed of an extensive synonymy on that account. The relation of the height to the length and the umboidal ratio are fairly constant, but the shell varies in almost every character. There is much difference in the thickness of the shell, due to the station, and whole colonies will be found where the epidermis is a rusty black instead of the typical shiny green. There have been numerous varieties of this species described, and the form called var. *gigantea* is present in Kansas waters, but I think the series of intermediates is so complete that it does not merit even the distinction of a variety. I regard the *A. bealii* reported from this state as a synonym of *grandis*.

Anodonta danielsii LEA. Not figured.

Anodonta danielsii Lea, Proc. Acad. Nat. Sci. Phila., II, 1858, p. 139.

Shell long, thin, elongate elliptical, slightly inflated. Anterior margin rounded; ventral margin gently bowed; posterior margin roundly pointed; dorsal margin straight or slightly curved, and meeting the posterior margin at an angle of about 155 degrees. Umboidal ratio, approximately 0.28. Umbones prominent but not inflated, and sculptured with two or three sets of rather small, deep, double loops. Umboidal slopes gently rounded. Epidermis smooth and

polished, seal- to olive-brown, the umbones light brownish drab; posterior umboidal slope roughened and very dark brown or black. Eradiate or showing the slightest traces of rays. Lines of growth continuous and imbricated marginally.

Interior: Hinge line slightly thickened; anterior scars lightly impressed, large, often fused. Posterior scars faintly marked, large, confluent. Pallial line sometimes marked. Cavity of the beaks and shell deep. Nacre silver-white and iridescent.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
130	68	47	0.27—	154°	(220.1)
116	61	35	.28+	156°	(217.1)
100	53	34.5	.275	153°	(216.1)
86	41	36	.29	154°	(30.1)

This species is confined to the rivers of Kansas and Indian Territory. In Kansas it has been reported from twenty localities, scattered all over the state and in all the drainage areas. Its reported western range is Big creek, in Ellis county (Call). The largest specimens I have seen are from the Smoky Hill river at Salina. This species is not rare in any of the drainage areas.

The relation of the height to the length, the umboidal ratio and the dorsal posterior marginal angle are all remarkably constant in the series which I have examined. It is a slenderer species than *A. grandis*, and is more cylindrical and less pointed posteriorly. The color of the epidermis is quite different from that of the typical *grandis*. The specimens reported by Call as *A. dejecta* are without doubt this species.

Anodonta opaca LEA. Plate LXXV.

Anodonta opaca Lea, Trans. Amer. Phil. Soc., x, 1852, p. 285, pl. xxv, fig. 46.

Shell large, thin, broadly elliptical, inflated. Anterior margin rounded; ventral margin straight or slightly bowed; posterior margin roundly biangulate, the dorsal half sometimes slightly incurved. Umboidal ratio, two-fifths of the entire length of the shell. Umbones large, high, and much inflated, marked with several concentric, nodulous, double-looped ridges. Anterior and lateral umboidal slopes abruptly curved; posterior slope abrupt and often slightly incurved. Epidermis smooth and shining, yellow, with a light green

cast, obscurely marked with numerous fine greenish rays, which extend over the anterior and lateral slopes; the umbones often of an olive-gray color. Lines of growth prominent, raised, but smooth anteriorly, imbricated posteriorly. Ligament long, fairly stout, of a light brown color.

Interior: Hinge line gently bowed. Muscle scars large and faint; the anterior scars of almost equal size, and distinct; the posterior scars confluent. Pallial line hardly visible, wavy. Cavity of shell large, of umbones very large. Nacre silvery or pinkish, moderately iridescent.

Length.	Height.	Breadth.	Um. ra.	
119	82	54	42	(Coll. W. C.)

A. opaca is a Southern species. Its range is from Louisiana and Mississippi north to Kansas. I know of only one locality for this form in Kansas: Quimbly creek, in Clay county, a small tributary of the Kansas drainage. Doubtless it also occurs in the southern series of the state.

This form can hardly be confused with any other Anodon. It resembles *A. grandis* in coloring and slightly in outline, but the ratio of the height to the length in *grandis* is as 1 to 2, while in the form under discussion it is as 2 to 3. The high and extremely full beaks are very characteristic.

GENUS **ANODONTOIDES** SIMPSON.

"Shell elliptical, inflated, thin, with a faint posterior ridge, sometimes constricted at the center of the base; beaks rather full, with a few coarse, subparallel, concentric ridges, which are curved up rather suddenly behind, and back of these are some fine radiating ridges; epidermis smooth, shining, often rayed; hinge line slightly incurved in front of the beaks, edentulous or bearing the merest rudiments of teeth; muscle scars shallow, irregular; nacre bluish white.

"Animal with the marsupium occupying the outer and sometimes the four leaves of the branchiæ; ovules more numerous in the outer, the whole pad-like; gills large, inner semicircular, free from the abdominal sac or united to it; branchial opening large, with many small papillæ; anal opening with well-developed papillæ." (Simpson.)

Anodontoides ferussacianus LEA. Plate LXXIV, fig. 2.

Anodontoides ferussacianus Lea, Trans. Amer. Phil. Soc., v, 1834, p. 45, pl. VI, fig. 15.

Shell of moderate size, elliptical, narrowing posteriorly, thin, slightly inflated. Anterior margin fully rounded; ventral decidedly bowed, sometimes a little incurved centrally; posterior margin roundly pointed, dorsal margin straight to slightly curved. Umbones of moderate height and inflation, and ornamented with several ridges, which are bluntly pointed posteriorly. Anterior and lateral umboidal slopes fully rounded; posterior slope often slightly excavated near the dorsal margin. Epidermis smooth and shining, of dark olive-green or brown, lightest over the umbones, and often ornamented with wide, rather obscure dark green rays. Lines of growth dark and continuous, but not generally imbricated or roughened. Ligament weak and light brown in color.

Interior: Hinge line slightly thickened, slightly incurved in front of the beaks, and sometimes showing a slight rudiment of a pseudocardinal. Muscle scars fairly well outlined, large, the anterior scars distinct, the posterior scars confluent. Pallial line outlined for its entire length. Cavity of the shell large, of the beaks slight. Nacre white or bluish, slightly iridescent.

Length.	Height.	Breadth.	Um. ra.	
75	37	22	0.30	(Coll. W. C.)

This species is found throughout the Mississippi drainage and in a number of rivers of eastern Canada. In Kansas it has been reported only from the northern or Kansas drainage. In this area we have a series of reports extending from the eastern boundary of the state west to Sappa creek, near Oberlin. Call (5.) This is the extreme western range of the Kansas Unionidæ as at present reported.

When young this species is easily identified by its bright green shell and striking rays, but the older shells lose these characters. It may be separated from *Anodonta grandis* by its more pointed beaks, cylindrical shell, and gradually pointed posterior margin. This last is not always constant.

GENUS **SYMPHYNOTA** LEA, 1829.

"Shell elliptic rhomboid, compressed; beaks low, sculpture consisting of strong bars; one pseudocardinal in the right valve and two in the left, the hinder somewhat ∧-shaped, cutting off the hinge plate in the right valve; laterals generally imperfect.

"Animal with the gills semicircular below, inner the larger, filling nearly the whole length from the abdominal sac; marsupium thick, pad-like, filling the outer gills; mantle strongly attached at pallial line; branchial opening papillose; anal opening without papillæ." (Simpson.)

Symphynota costata RAFINESQUE. Plate LXXVI, fig. 1.

Alasmidonta costata Rafinesque, Ann. Gen. Sci. Brux., v, 1820, p. 318, pl. LXXXII, figs. 15, 16.

Alasmodonta rugosa Barnes, Amer. Jour. Sci. and Arts, VI, 1823, p. 278, pl. XIII, fig. 21.

Shell large, elongate oval, moderately thick, compressed in male, less so in female. Anterior margin an abrupt curve; anterior portion of ventral margin gently curved, posterior portion straight; posterior margin roundly biangulate; dorsal margin straight or slightly curved. Umboidal ratio, from 0.25 to 0.30. Umbones flat and low, marked with three very coarse, parallel ridges. Umboidal slopes all flatly rounded, the posterior slope marked with a series of moderate-sized undulations which are curved slightly upward anteriorly. Lines of growth coarse, numerous, continuous. Epidermis horn color to deep brown. Ligament long, dark brown.

Interior: Pseudocardinals large, erect, serrate, double in the left and single in the right valve. Lateral teeth indicated only by an indistinct broken ridge on each hinge plate. Anterior scars rather large, smooth; adductor cicatrix deeply impressed in its dorsal portion; retractor cicatrix lightly impressed and generally fused at the anterior end with the adductor cicatrix. Posterior scars large, lightly impressed, fused. Dorsal cicatrices a row of small scars almost at the base of the pseudocardinals. Pallial impression sometimes well marked. Cavity of the umbones slight, of the shell moderate. Nacre rich cream color in the cavity of the shell, white marginally, iridescent posteriorly.

Length.	Height.	Width.	Um. ra.		
126	65	37	0.27	♂	(15.2)
106	62	48	.28	♀	(15.1)
130	68	44	.30	♂	(Coll. W. C.)
115	68	43	.29	♀	(Coll. W. C.)

S. rugosa is distributed throughout the Mississippi valley, and is also found in Manitoba, in the St. Lawrence drainage, and at Columbus, Miss. In Kansas it has been found only in the Neosho river and two of its tributaries, the Cottonwood river and Fall river. I do not believe this to be a common species at any place in the state.

There will be no difficulty in identifying this form. The peculiar lateral teeth rudiments will at once indicate the genus and the rugose posterior slope the species. The two sexes are easily distinguished; the female is much shorter and more inflated than the male. Aside from the sexual variation, the only other decided variant is the number and character of the posterior undulations.

Symphynota complanata BARNES. Plate LXXVI, fig. 2.

Alasmodonta complanata Barnes, Amer. Jour. of Sci. and Arts, VI, 1823, p. 278, pl. XIII, fig. 21.

Shell large, moderately thick anteriorly, thinner posteriorly, wide ellipsoid, compressed in male, less so in female; young specimens strongly alate, but this character often lost in older specimens. Anterior margin rounded; ventral margin well rounded in female, less so in the male; posterior margin roundly biangulate in young, rounded in old specimens. Wing high in old, pointed in young specimens. Umboidal ratio, 0.20 to 0.25. Umbones flattened and marked with four or five rows of double-looped, coarse, V-shaped ridges. Umboidal slopes flattened in male, flatly rounded in female. Epidermis in young specimens smooth, shiny, light to dark brown, sometimes rayed, in old specimens rough, dark brown to black, eradiate. Lines of growth raised, continuous, numerous, sometimes slightly wavy at the base of the wing. Ligament long, light brown.

Interior: Pseudocardinals variable, generally double in left and single in the right valve, large, pyramidally serrate. Lateral teeth indicated by a low, irregular ridge on each hinge plate. Interdentum sometimes present, sometimes ex-

cavated in the right valve to form a socket for the anterior left pseudocardinal. Anterior muscle scars not deeply excavated but large. Posterior scars large, fused, lightly outlined. Pallial line slightly impressed anteriorly, outlined posteriorly. Dorsal muscle scars pitted, numerous on posterior face of pseudocardinals. Cavity of the beaks slight, of the shell moderate, greatest in females. Nacre white, iridescent posteriorly.

Length.	Height.	Breadth.	Um ra.	P. v.-p. d. angle.		
188	110	52	0.21+	140°	♂	(16.1)
171	105	62	.21	131°	♀	(16.2)
134	78	34	.23	155°	♂	(16.3)
160	96	56	.22+	138°	♀	(*)
162	92	51.5	.23	142°	♂	(*)

S. complanata is found in the Mississippi drainage north of the Arkansas river and in the St. Lawrence drainage. It is a common species in all the drainage basins of Kansas, and has been reported as far west as Wichita and the Solomon river at Minneapolis. It ranks close to *Lampsilis luteola* in abundance in the streams of the northeastern part of the state. Although most abundant in water from six to twelve feet in depth and in a mud bottom, smaller specimens may often be found in company with such forms as *Quadrula plicata* and *Tritogonia tuberculata* in swift-flowing water of a foot or less in depth and embedded in a gravelly bed. It attains a size equal to any *Unio* in the state. It possesses a strong musculature, is a rapid burrower, and is very tenacious of life.

GENUS **UNIO** RETZIUS, 1788.

"Shell inequilateral, oval to elongated, rounded in front and pointed or biangulate behind, with a more or less developed posterior ridge, often becoming slightly arcuate when old; beaks only moderately full, generally sculptured with coarse ridges, which run parallel with the growth lines, or are somewhat doubly looped, sometimes broken and showing fine radiating lines behind; surface smooth, slightly concentrically ridged or pustulose; epidermis rather dull colored, rayless or feebly rayed; hinge plate narrow, two pseudocardinals and two laterals in the left valve, and one pseudocardinal and one

* From Minneapolis, Kan., high-school collection.

lateral in the right, with rarely a vestige of a second lateral; cavity of the beaks not deep or compressed.

"Animal having the inner branchiæ free from the abdominal sac for from one-half to their entire length; marsupium occupying the whole length of the outer gills only, forming a thick, smooth bag when filled with young; gills united to the mantle behind to their extreme points or very nearly so; papillæ on branchial and anal openings unbranched; superanal opening always closed below." (Simpson.)

Unio gibbosus BARNES. Pl. LXXVII.

Unio gibbosus Barnes, Amer. Jour. Sci. and Arts, XIV, 1828, p. 286.
Unio arctior Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 10, pl. IV, fig. 10.

Shell rather large, thick, but variable in this respect, thickest anteriorly, elongate, flat ellipsoid, often tapering posteriorly, compressed. Anterior margin shortly rounded; ventral margin straight, often slightly sulcate posteriorly; posterior margin more or less roundly pointed; dorsal margin long and curved, sometimes curving insensibly into the posterior margin, oblique, and set on an average angle of about twenty-five degrees from the ventral margin. Umboidal ratio quite constant, approximately one-fourth of the entire length. Umbones flat, and marked with several coarse concentric ridges. Anterior umboidal slope rounded; lateral slope flatly rounded and sometimes marked with a broad, shallow radial furrow posteriorly; posterior umboidal slope abruptly curved; umboidal ridge quite well marked. Lines of growth numerous, continuous, in older specimens imbricated, particularly posteriorly. Ligament long, stout, rich brown in color. Lunule long and slender.

Interior: Pseudocardinals low, rounded, thick, evenly serrate, double in the left and single in the right, but often with one or two auxiliary spurs in the right valve. Laterals long, more or less oblique, straight, slightly curved, slightly roughened posteriorly. Interdentum broad and long. Anterior adductor cicatrix of moderate depth and size, sometimes placed slightly under the anterior pseudocardinals, particularly in old specimens. Retractor cicatrix well impressed, variable in shape and size. Posterior scars moderate

in size, long, somewhat fused, impressed, often deeply. Pallial line impressed anteriorly and often its entire length. Dorsal cicatrices a row of pits on the under side of the interdentum. Hardly any umboidal cavity; cavity of shell moderate, branchial outline distinct. Nacre from milk-white to pink or deep purple, sometimes almost leaden, often white anteriorly and purple posteriorly; iridescence hardly present.

Length.	Height.	Width.	Um. ra.	
107	47	31.5	0.21	(53.1)
114	52	34	.19+	(250.1)
108	50	35	.21	(300.1)
115	48	34	.21	(53.2)
99	50	35.5	.19+	(300.1)

U. gibbosus is distributed throughout the Mississippi drainage, the St. Lawrence drainage, and the Alabama drainage. It is also found from northern Florida west to the Guadalupe river, Texas. Its distribution in Kansas is rather peculiar. In the clear waters of the southern drainage it is a common species; in the Marais des Cygnes and its tributaries it is very abundant, perhaps the most so of any *Unio*. In the Kansas drainage, however, I know of only one specimen being found. This was a single valve, picked up at Blanton ford, on the Wakarusa river, near Lawrence. This is the only specimen from this stream, although the river has been thoroughly collected. It is found both on gravel bars and riffles, and in deep water, embedded in the mud.

Certain characters of the shell of this species are extremely variable. Perhaps the color of the nacre is the most striking of these. It is possible to make up a complete series of specimens of this species, showing a gradual variation of nacre from a deep leaden purple to pure white. Of the white forms the most common is that with a tinge of purple dorsal-anteriorly. Occasionally specimens are found in which the cavity of the shell is pink. In my experience the purple nacre form is the most common in the Neosho river, while the white nacre form is the most abundant one in the Marais des Cygnes. The thickness of the shell is quite variable. There is also much variation in the length and curvature of the dorsal margin; in some specimens the extreme curvature and length of this margin give the shell a peculiar humped

appearance. The relation of the height of the shell to its length is commonly about as one to three, but specimens often occur in which the height is one-half or more of the length. It is a peculiar fact that in spite of the variation in the thickness and height of the shell the cubic capacity of the valves bears a quite constant relation to their length. The umboidal ratio is also fairly constant.

U. gibbosus is an easily recognized species in spite of its variation. The only forms with which it might be confused are *Lampsilis recta* and *Ptychobranchus phaseolus*. The distinguishing characteristics are mentioned in the notes on those two species.

Unio tetralasmus SAY. Plate LXXVIII, fig. 1.

Unio tetralasmus Say, Amer. Conch., III, 1830, pl. XXIII.
Unio symmetricus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 164.
Unio jamesianus Lea, Proc. Acad. Nat. Sci. Phila., I, 1857, p. 84.

Shell moderate to large, moderate thickness, long elliptical, slightly compressed. Anterior margin rounded; ventral margin slightly bowed and forming quite a sharp angle with posterior margin; posterior margin straight or slightly bowed; dorsal margin straight and forming an approximate angle of 140 to 145 degrees with the posterior margin. Umboidal ratio, 0.20 to 0.30. Umbones full, decurved, and marked with from five to eight rather coarse concentric ridges. Anterior umboidal slope fully rounded; lateral slope moderately rounded; posterior slope slightly angular. Epidermis smooth and shining, except for an occasional narrow rough band and for the dorsum of the posterior slope; in color from light horn to dark seal-brown, sometimes marked obscurely with fine rays of dull olive-brown. The color of the epidermis is often arranged in broad concentric but not continuous bands of light and dark; umbones generally brown. Lines of growth fine, slightly imbricated, and continuous. Ligament long, narrow, and black.

Interior: Pseudocardinals thin, erect, plate-like, high or low, double in left and single in the right valve, as a whole very variable. Laterals thin, of moderate length, and slightly curved. Anterior muscle cicatrices large and only fairly well

impressed; posterior scars large, outlined, but not impressed, confluent. Dorsal cicatrices large, shallow pits in the cavity of the umbones. Pallial line marked its entire length, but not compressed. Cavity of the beaks slight, of the shell moderately large. Branchial outlines sometimes slightly marked. Nacre a silvery white.

Length.	Height.	Breadth.	Um. rá.	Dorsal posterior angle.	
70	34	21	0.26	144°	(180.1)
57	29.5	17.5	.20	145°	(180.2)
90	50	30	.24	140°	(*)
67	34	21.5	.26+	140°	(*)
75	36	24	.25	138° (approx.)	(*)

Unio tetralasmus var. **camptodon** SAY. Not figured.

Unio camptodon Say, Amer. Conch., v, 1832, pl. XIII.

Unio geometricus Lea, Trans. Amer. Phil. Soc., v, 1832, p. 38, pl. IV, fig. 10.

To be distinguished from the foregoing by a slightly more rhomboid outline and in dull, drab-colored and cloth-like epidermis, which is roughened by frequent coarse, continuous lines of growth. Otherwise agreeing with the species proper.

The general distribution of *U. tetralasmus* is throughout the Mississippi valley as far north as forty degrees latitude and southwest to Mexico. It is also found in the Ohio and Alabama river systems.

In Kansas this species is found in all the drainage areas, but perhaps most frequently in the small, muddy tributaries and the large ponds and lakes of the southern drainage basin. There is hardly another species which has an equal range over the state; it has been reported from as far west as Garden City (Call) in the southern drainage, and as a tributary of the Solomon river at Minneapolis in the Kansas area. I have seen some specimens of remarkable size and beauty from the latter place. It is often found in the Wakarusa river at Lawrence.

In all the material which I have gone over and have personally collected, I have found only one lot which could be referred to the variety *camptodon*. This material was from a pond near Thayer, Neosho county. As Doctor Call did not dis-

*Collection Minneapolis high school.

criminate between the variety and species in his list, it is impossible to make out the respective localities of his material.

There is hardly a *Unio* more subject to variation than this one, particularly in the character of the epidermis and the posterior outline. However, the relation of the height to the length (approximately 1 to 2) and the dorsal posterior angle remain remarkably constant. The species can best be identified by the peculiarly undulated beaks and the broken concentric bands of color of the epidermis.

GENUS **PLEUROBEMA** (RAFINESQUE, 1820) AGASSIZ.

"Shell solid, triangular to rhomboid, usually with a prominent umboidal region; beaks at or near the anterior end of the shell, incurved and pointed over a small but well-developed lunule; beak sculpture coarse, consisting of a few irregular, often-broken ridges with a curve upward posteriorly; posterior ridge present, but low and rounded; epidermis showing rest periods plainly, tawny to olive, often ornamented with rays which show a tendency to break into square spots; hinge rather strong, the plate generally narrow; pseudocardinals double in both valves, in the right valve the inner being smaller; muscle scars deep, the posterior rounded, cavity of the beaks shallow; nacre silvery; male and female shells essentially alike.

"Animal having the inner gills much the larger, rounded below, free from the abdominal sac for a part or all of their length; marsupium occupying the entire outer gills, the ovisacs in some cases seeming to be arranged in pairs. Animal generally yellowish to salmon-red, sometimes more or less brown or blackish." (Simpson.)

Pleurobema æsopus GREEN. Plate LXXVIII, fig. 2.

Unio æsopus Green, Cont. Mac. Lyceum, I, No. 2, 1827, p. 46, fig. 3.
Unio cyphia Conrad, New Fresh-water Shells, 1834, p. 68.

Shell large, thick, particularly anteriorly, roundly trapezoidal, tapering behind, rather inflated dorso-anteriorly. Anterior margin fully rounded; ventral margin gently and equally curved, slightly emarginate posteriorly; posterior margin roundly biangulate; dorsal margin straight and somewhat

oblique. Umboidal ratio in specimens examined averaged 0.12 to 0.18. Umbones ornamented with several coarse concentric ridges and a few fine radiating lines. Anterior slope full and rounded; lateral slope rounded anteriorly, occupied by a broad, distinct radial furrow, which extends from the tip of the umbone to the ventral margin; on each side of the dorsal half of the radial furrow is found a scattered row of large, low tubercles which are often quite obscure; posterior umboidal ridge prominent. Posterior slope narrow, abrupt, decidedly incurved dorsally, with broken transverse ridges on the upper half. Epidermis dark horn, brown, black. Lines of growth pronounced and continuous, imbricated marginally. Ligament long, of moderate thickness, dark brown. Lunule well developed.

Interior: Pseudocardinals large, erect, ragged, double in the left and single in the right valve, the right pseudocardinal arising from a pit. Interdentum narrow, not very long. Laterals long, straight, slightly oblique. Anterior adductor cicatrices deeply excavated, rough, roundly triangular in outline; anterior retractor scar deeply pitted; posterior scars large, lightly impressed, fused; dorsal scars large on the lower surface of the interdentum and the base of the pseudocardinals. Pallial line impressed anteriorly, outlined posteriorly. Cavity of beaks and shell moderate. Nacre pearly white.

Length.	Breadth.	Height.	Um. ra.	
125	54	82	0.18	(460.1)
78	43	58	.12+	(Coll. W. C.)
90	42	55	.15+	(471.1)

This species is found in the Cumberland, Ohio and Tennessee river systems, and ranges west to Kansas. I have seen only three specimens from Kansas. These came from the Verdigris river at Coffeyville. They are of the typical form.

Pleurobema cicatricosum SAY. Not figured.

Unio varicosus Lea, Trans. Amer. Phil. Soc., IV, 1829, p. 90, pl. XL, fig. 20.

Unio cicatricosus Say, New Harm. Diss., II, No. 19, 1829, p. 292.

Shell large, thick, extremely ponderous in the region of the umbones and anteriorly, elongately and roundly triangu-

lar in outline, subinflated. Anterior margin straight or slightly incurved dorsally, bluntly rounded below; ventral margin straight or slightly emarginate; posterior margin produced below and roundly pointed; dorsal margin oblique and forming a continuous curve with the posterior margin. Umboidal ratio, *nil.* Umbones very full and high, and directed anteriorly, ornamented with a few coarse ridges. Anterior umboidal slope slightly incurved or straight, very abrupt, lateral margin fully rounded anteriorly and flatly rounded posteriorly, ornamented with a number of coarse, concentric folds, which are variable in their elevation; posterior umboidal slope abrupt, slightly rounded. Epidermis marked with numerous coarse, continuous lines of growth, rusty brown to black in color. Lunule large, ligament thick.

Interior: Pseudocardinals high, rough, heavy, double in the left and single in the right valve; the left pseudocardinals sharp, ∧-shaped ridges, of which the posterior is the longer, meeting at right angles dorsally; right pseudocardinal a high truncate pyramid arising from a pit. Interdentum broad and short, cut away in the right valve. Laterals heavy, long, oblique, slightly curved. Anterior adductor cicatrix rather small, very deep, elongate, semicircular in outline; posterior muscle scars rather small, deeply impressed, distinct; dorsal muscle scars extending from the anterior adductor cicatrices to the anterior end of the lateral teeth. Pallial line impressed its entire length. Cavity of the shell not large, of the beaks slight; branchial impression well marked. Nacre satin-white.

Length.	Height.	Breadth.	Um. ra.	
75	53*	47	*nil.*	(477.1)

The range of this species as given by Simpson is the Ohio river, Tennessee, and possibly Claiborne, Ala. This is the first report of its occurrence west of the Mississippi. The one specimen which was found came from a gravel-bed on the Neosho river near the southern state line.

There is considerable variation in the extent of the folds on the lateral slopes.

*Taken through region of pseudocardinals.

TETRAGENEÆ.

"Male and female shells alike, solid; beak sculpture consisting of coarse subparallel ridges; beak cavities deep; marsupium filling all four gills, smooth, pad-like." (Simpson.)

Genus **QUADRULA** (Rafinesque, 1820) Agassiz.

"Shell triangular quadrate or rhomboid, solid, inflated, with rather prominent beaks, which are generally sculptured with a few coarse, irregular, subparallel ridges that are inflated when they cross the posterior ridge; posterior ridge ordinarily well developed; base often incurved in old specimens; disks sculptured or smooth; epidermis usually dull colored, dark, and rayless or feebly rayed; hinge plate heavy, wide, flattened; pseudocardinals solid, direct, ragged; laterals double in the left and single in the right valve, often with a secondary lateral below the large one in the right valve; cavity of the beaks deep and compressed; dorsal scars under the hinge plate; male and female shells alike.

"Animal having the inner gills the larger, generally free from the abdominal sac the greater part or all of their length; marsupium occupying all the four gills throughout, the whole smooth and pad-like." (Simpson.)

Quadrula plicata Say. Plate LXXIX.

Unio plicata Say, Nich. Encyc., II, 1816, pl. III, fig. 1.

Shell large, thick, particularly anteriorly, wide, oval in outline. Anterior margin flatly curved; ventral margin gently bowed; posterior margin bluntly rounded or roundly biangulate; dorsal margin straight or slightly curved and slightly oblique. Umbones large, inflated, high, directed anteriorly, sculptured at the tips with several coarse ridges. Umboidal ratio, from 0.07 to 0.14. The disk of the shell covered with from four to nine coarse, parallel, more or less irregular folds, which extend obliquely from the highest portion of the beaks to the ventral and posterior margins. Anterior slope short, abrubtly curved; posterior slope somewhat abrupt, slightly excavated, sometimes marked with a series of short plications

which are directed upwards at the dorsal margin. Epidermis dark brown to black in color, rough except over the umbones. Lines of growth coarse and continuous, imbricated marginally. Ligament long and stout, black. Lunule large.

Interior: Pseudocardinals large, high, heavy, ragged, double in the left, and single and sometimes double in the right valve; when double the right anterior tooth is small and low. Laterals of moderate length, stout, curved slightly downward. Interdentum broad, flat, cut away in the right valve to receive the posterior left pseudocardinal. Anterior muscle cicatrices large, long, and narrow, of only moderate depth, with roughened floors; adductor cicatrix often curved a little around the anterior pseudocardinal. Posterior scars large, lightly impressed, fused. Pallial line heavily impressed and crenulate anteriorly. Cavity of the beaks not large, of the shell fairly large. Nacre white, very iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
150	99	71	0.09	(14.1)
134	86	47.5	.08	(314.1)
113	78	53	.09	(316.1)
120	87	64	.12	(318.1)
101	55	47.5	.09	(314.3)

Q. plicata ranges from Lake Winnipeg and Lake Erie south to the Arkansas and Tennessee rivers. It is common in all Kansas drainage areas, although it is not as abundant as the closely related *Q. undulata*. It is reported as far west as the Whitewater river in the Arkansas drainage (Call), and as Wild Cat creek, Riley county, in the Kansas drainage (Popenoe). I do not think that the species ranges much further west than this latter point. *Plicata* is found buried in deep mud in from two to ten feet of water, along with such forms as *Symphynota complanata* and *Tritogonia turberculata*. In favorable conditions the shell becomes very massive and attains some size; a specimen from the Blue river was 165 mm. in length and the dry shell weighed 800 grams. Another specimen was 195 mm. in length.

Q. plicata is separated from the other undulate *Unios* by its full, high beaks and curved dorsal margin. The plications are very variable in extent and distinctness.

Quadrula perplicata CONRAD. Not figured.

Unio perplicatus Conrad, Proc. Acad. Nat. Sci. Phila., I, 1841, p. 19.
Unio atrocostatus Lea, Trans. Amer. Phil. Soc., X, 1847, p. 70, pl. II, fig. 5.

Shell large, quite thick, somewhat inflated, quadrate, wider before than behind. Anterior margin flatly rounded; ventral margin regularly and gently bowed; posterior margin flatly rounded, inclined to be biangulate; dorsal margin straight, directed somewhat upward. Umboidal ratio, about 0.25. Umbones fairly inflated, but not very high. Anterior umboidal slope rather abruptly rounded; lateral slope fully rounded; posterior slope wide, flattened, inclined to be slightly excavate. Lateral slope ornamented with a series of more or less regular folds, four to seven in number, directed obliquely across the disk from the umbones to the ventro-posterior margin; the posterior slope bearing a continuation of the series of folds, which in this region are smaller, arranged more transversely, and bowed dorsally at either end. Epidermis glossy chestnut brown, with imbricated lines of growth marginally. Lunule small. Ligament short and stout.

Interior: Pseudocardinals of moderate size and height, roundly pyramidal, double in the left, and single, with sometimes one or two auxilaries, in the right valve. Interdentum broad, smooth, rather long. Laterals short, straight, a little oblique. Anterior adductor cicatrix evenly and shallowly excavated, with a roughened floor, uniform in outline; posterior scars broader than long, lightly impressed, confluent; dorsal muscle scars on the lower surface of the interdentum and pseudocardinals. Pallial line impressed and crenulate the first two-thirds. Cavity of beaks and shell fairly large. Nacre a beautiful silver-white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
87	50	44	0.23	(470.1)

Q. perplicata is a Southern species, found in the Alabama drainage and the streams flowing into the Gulf of Mexico, as far west as central Texas and north to Kansas. The only specimens from Kansas of which I have personal knowledge are two received from Doctor Newlon, from the Neosho river

at Oswego. Simpson (20) state sthat this form is found in southern Kansas, but gives no exact localities.

This species is shorter and higher than *Q. plicata;* and the dorsal margin of *Q. perplicata* is straight and directed upward, while that of *Q. plicata* is generally curved and directed ventrally. The rather high beaks of *Q. perplicata* will serve to distinguish it from *Q. undulata.*

Quadrula undulata BARNES. Plate LXXX, fig. 2.
Unio undulatus Barnes, Amer. Jour. Sci., VI, 1823, p. 120, pl. II.

Shell large, solid, thickest anteriorly, elongate quadrate in outline, somewhat compressed. Anterior margin flatly rounded; ventral margin gently bowed; posterior margin roundly biangulate, the dorsal posterior margin being approximately three times the length of the ventral posterior margin; dorsal margin straight, except for the posterior third, which is slightly curved. Umboidal ratio extremely variable, from 0.10 to 0.30. Umbones compressed, flattened, and incurved, marked with from four to six coarse, concentric ridges. Disk of the shell covered with a series of coarse oblique folds, which run from the highest points of the umbones to the posterior and dorsal margins. The plications are from five to eight in number, but break up considerably marginally. Posterior umboidal slope slightly excavated and covered with a parallel series of undulations, which are directed dorsally. The anterior of these undulations arise independently on the umbones; the posterior ones are continuations of the dorsal disk undulations. Epidermis chestnut brown to black in color. Lines of growth coarse, numerous, continuous, imbricated posteriorly. Ligament long, stout, black. Lunule long and slender.

Interior: Pseudocardinals of moderate size, double in both valves, those of the left valve high, pyramidal, ragged; the posterior of the right valve high, rough, and pyramidal, the anterior small and lamellar. Interdentum long and narrow, cut away in the right valve to receive the posterior right pseudocardinal. Laterals long, either thick or thin, slightly curved. Anterior adductor cicatrix kidney-shaped, of moderate and even depth, floor roughly pitted; protractor cicatrix large and

rough; posterior scars large, faint, confluent. Pallial line impressed and crenulate for the anterior two-thirds of its length. Dorsal muscle scars variable in shape and number. Cavity of the beaks deep, of the shell moderate; branchial depression well outlined. Nacre white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
130	80	53	0.26	(14.1)
105	67	35	.18+	(312.2)
90	58	39	.26	(14.2)
110	72	37	.13+	(312.1)
114	58	42	.12	(313.1)

Quadrula undulata var. **latecostata** LEA. Not figured.

Unio latecostatus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 163.

Distinguished from the species proper by the finer and more regular undulations and thinner and more compressed shell.

Quadrula undulata var. **pilsbryi** MARSH. Not figured.

Unio pilsbryi Marsh, Nautilus, V, 1891, p. 1.

Differs from the species in being produced ventro-posteriorly and in bearing plications which tend to break up into short transverse bars.

Q. undulata has very extensive distribution. It is found throughout the Mississippi basin north into Canada and the St. Lawrence drainage, south in the Alabama river system, west almost to Mexico. It is a common species in all the drainage areas of Kansas, but is, perhaps, most abundant in the smaller tributaries of the Kansas river. Here it stands next to *Lampsilis luteola* in abundance, and the riffles are often covered with the shells. The reported range is as far west as the Smoky Hill river at Salina; it probably goes much further west. On Chapman creek, a tributary of the Smoky Hill, it is very abundant; in a lot of about 150 shells, fully fifty per cent. were *Q. undulata*, but there was not a single specimen of the nearly related *Q. plicata* in the lot.

The variety *latecostata* is found only in the southern drainage. The best examples I have seen were from Lake Thayer, in Neosho county. Simpson (20) has stated that it is in Kansas that this form merges with the true species. This I believe to be true, for while transitional forms between the va-

riety and the species are common in the Kansas river drainage, the typical variety is yet to be found there.

The form *pilsbryi* was originally described as a distinct species from Arkansas. Specimens of the variety from Kansas correspond very well with specimens of *pilsbryi* from the former state. As yet it has been reported from only two localities in the state—Ottawa creek, a small tributary of the Marais des Cygnes, and Mill creek, in the Kansas drainage.

This species is not particular as to habitat, and its distribution is entirely uninfluenced by the depth of the water in which it lives; sandy bottoms, however, are avoided. The main distinctions between this and other closely related forms has been already pointed out.

Quadrula heros SAY. Plate LXXX, fig. 1.

Unio heros Say, New Harm. Diss., II, No. 19, 1829, p. 29.

Unio multiplicatus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 70, pl. IV, fig. 2.

Shell large, of moderate thickness, rhomboid in outline, compressed anteriorly, somewhat inflated medianly. Anterior margin flatly rounded; ventral margin gently curved; posterior margin straight except for the slight undulations caused by the folds of the shell; dorsal margin straight. Umboidal ratio, 0.08 to 0.12. Umbones rather flattened and sculptured, with very coarse double-looped ridges, which further down the disk break up into rows of crescent-shaped nodules, which extend from one-half to one-third of the distance down the anterior slope. Anterior and lateral slopes flatly rounded; posterior slope slightly excavated. Disk ornamented with a series of oblique coarse folds, which extend from a line on the disk which would pass through the umbones to the posterior margin. The dorsal ridges curve decidedly upward to the dorsal margin. Epidermis very dark brown to black. Lines of growth numerous and continuous and imbricated posteriorly. Ligament short, thick, dark brown.

Interior: Pseudocardinals large, high, heavy, ragged, double in the left and single and sometimes double in the right valve; when double in the right the anterior tooth is

small and weak. Laterals short, stout, curved slightly ventrally. Interdentum broad and flat, but cut away in the right valve to receive the posterior pseudocardinal. Anterior muscle cicatrices both long and narrow, of moderate depth, and with roughened floors; the anterior pseudocardinal often curved about half-way around the base of the pseudocardinals. Posterior scars large, lightly impressed, longer than wide, confluent. Pallial line crenulate and heavily impressed anteriorly. Dorsal scars well impressed, scattered over the ventral surface of the interdentum. Cavity of the shell quite deep, of the beaks large. Nacre pure white, very iridescent along the posterior margin.

Length.	Height.	Breadth.	Um. ra.	
150	99	71	0.09	(14.1)
134	86	47.5	.08	(314.2)
113	78	53	.09	(316.1)
128	87	64	.12	(318.1)
101	55	41.5	.09	(314.3)

Q. heros is found throughout the Mississippi valley, east into Alabama, west into Mexico. It has been reported from all the drainage systems in Kansas. In the Kansas and the southern drainage basins it is a rare species. In the Marais des Cygnes system it is occasionally found, but it is not at all common. Although this is said to be the largest *Unio* of American waters, I have not seen specimens of any great size from the Kansas streams. There will be no difficulty in distinguishing *heros* from the other undulate *Unios*. It is the only form in which the umbones and the greater part of the anterior umboidal slope are covered with pustules.

Quadrula cylindrica SAY. Plate LXXXI, fig. 2.

Unio cylindricus Say, Nich. Encyc., II, 1816, pl. IV, fig. 3.

Shell of moderate size, elongate rectangular, thick, inflated, nodulated, height about one-third of the length. Anterior margin almost semicircular; ventral margin straight except where it is inbowed by a long, very shallow indentation; posterior margin bluntly pointed, the ventro-posterior margin short and straight, dorsal posterior margin longer and incurved; dorsal margin straight and meeting the dorsal posterior margin at a fairly constant angle. Umboidal ratio, ap-

proximately 0.20. Umbones prominent but not high, marked with coarse lines and small nodules. Anterior umboidal slope fully rounded; lateral slope well rounded, and together with the anterior is marked with obscure, low, small, triangular-shaped elevations; in some cases the dorsal margin of the anterior slope is marked with a few small undulations. Posterior ridge well marked, rounded, with a series of from three to five large irregular nodules which vary greatly in their prominence. Posterior slope flat and more or less undulated. Lines of growth rounded and continuous. Epidermis horn color or russet, marked with numerous triangular patches of dark green, which extend only a short distance up from the ventral margin. Ligament fairly strong, long, dark chestnut.

Interior: Pseudocardinals rather small, low and pyramidal, double and sometimes trifid in each valve. Anterior cicatrices small, quite deep, sometimes fused; posterior scars of moderate size, very faintly outlined, confluent. Dorsal cicatrices small and located on the lower surface of the interdentum. Pallial line impressed in the anterior half. Nacre pure white, iridescent posteriorly.

Length.	Height.	Breadth.*	Um. ra.	Posterior ventral angle.	
97.5	40.5	30	0.20+	137°	(185.1)
100	39.5	30	.21	134°	(186.1)
96.5	41	30.5	.21+	130°	(186.2)
87	37	26.5	.20	131°	(186.3)

Q. cylindrica ranges from the Ohio, the Cumberland and the Tennessee river systems west to Kansas. It is found in Kansas only in the clear-water streams of the southern drainage—the Spring, the Neosho, and the Verdigris. Although seeming to be nowhere abundant, it is not a rare species in the streams mentioned. Its favorite habitat is bars of gravel or shingle in a rather swift current. The thick and nodulous shell fits it admirably for these conditions.

This is one of the most distinct and easiest recognized *Unios* found in Kansas waters. At first sight the elongate shell makes it appear out of place among the other members of its genus, but all the members of the small group to which

*This measurement is taken through the umbones.

it belongs have marked peculiarities of shell. The nodules vary much in different specimens, and I have seen specimens in which they were low and evenly rounded, but generally this is the most striking character of the shell. The epidermal markings and the pseudocardinals exhibit minor variations.

Quadrula metanevra RAFINESQUE. Plate LXXXI, fig. 1.

Obliquaria (*Quadrula*) *metanevra* Rafinesque, Ann. Gen. Sci. Brux., v, 1820, p. 305, pl. LXXXV, figs. 15, 16.

Shell generally of moderate size, thick, thickest anteriorly, somewhat compressed, trapezoidal in outline. Anterior margin and the anterior half of the ventral margin almost forming a semicircle, remainder of the ventral margin at first slightly incurved and then forming a rounded and produced lobe, of which the ventral portion of the posterior margin forms the upper part. Upper portion of posterior margin almost straight; dorsal margin straight or slightly curved. Umboidal ratio, approximately one-third. Umbones large and full; when not worn (as is usually the case), triangular and sharp. Anterior and lateral umboidal slopes fully rounded, and more or less ornamented with large, low, tubercles, sometimes entirely smooth; umboidal ridge very prominent, rounded abruptly anteriorly and posteriorly, widening ventrally, generally bearing several large irregular nodules and also low tubercles; posterior slope rounded and ornamented dorsally with obscure broken ridges. Lines of growth prominent, regular, and continuous. Epidermis variable in color, from straw to deep chestnut-brown, often marked with dark green triangular patches, the apices of which are directed vertically. Ligament short, thick, honey-brown to black in color.

Interior: Pseudocardinals large, low, massive, coarsely striate, double in the left valve, with one large and one or two low auxiliary teeth in the right valve. Laterals short, very heavy, generally curved, but sometimes straight oblique, sometimes inclined to be double in the right as well as the left valve. Interdentum broad and flat. Anterior adductor cicatrix well marked but shallow, placed in front of the pseudo-

cardinals; posterior scars large, lightly impressed, often fused, and sometimes roughened. Pallial line impressed anteriorly, sometimes throughout its length. Dorsal scars on the base of the interdentum. Cavity of the shell moderate, of the beaks deep. Nacre pure white.

Length.	Height.	Breadth.		
55	48.5	36	(242.1)	
77	63	49		(Coll. K. S. A. C.)
74	54	35	(241.2)	
77	60	41.1	(240.1)	

Q. metanevra occurs throughout the northern portion of the Mississippi valley. In Kansas it is confined to the clear-water rivers of the southern drainage, being found as far up the Neosho as its juncture with the Cottonwood river. Gravel-bars are its favorite habitat. Although well distributed it is never (in the author's experience) very common. The largest specimen I have ever seen from this state came from Fall river, a tributary of the Neosho. It is in the Popenoe collection of the State Agricultural College and its dimensions are given above.

It will be impossible to confuse this *Unio* with any other found in Kansas. The umboidal ridge, semicircular in outline, will alone serve to distinguish it. There is much variation in the character of the nodules found on the umboidal ridge. The Kansas representatives are all less nodulous in this region than are those of a series which I have examined from the Cumberland river of Tennessee.

Quadrula aspera LEA. Not figured.

Unio asper Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 85, pl. XIX, fig. 15.

"Shell subtriangular, angular behind and rounded before, covered with small, rough tubercles, except in a furrow which passes from the beak obliquely to the basal margin, which is there arcuate; the tubercles on the posterior slope arrange themselves into a series of undulations as far as the beaks; substance of the shell thick; beaks slightly prominent, ligament short and thick; epidermis brown and wrinkled; cardinal tooth rather large, slightly elevated, and widely cleft in the left valve, single emerging from a pit in the right; lateral teeth small, slightly curved in a direction over the cardinal

teeth; posterior and anterior cicatrices both distinct; dorsal cicatrices situated on the under part of the cardinal tooth, within the cavity; cavity of the beaks deep and angulated; nacre very pearly and iridescent." (Lea.)

This species, according to Simpson, ranges from Kansas south to Texas. I have never found this species in the state, nor is it present in any of the collections of Kansas *Unios* which I have examined. It is very close to *Q. lachrymosa.* I admit it only on Simpson's authority. Doctor Dall states that it has been collected from the Neosho in Indian Territory. The description is Lea's original in the Transactions of the American Philosophical Society.

Quadrula lachrymosa LEA. Plate LXXXII, fig. 2.

Unio lachrymosus Lea. Trans. Amer. Phil. Soc., III, 1828, p. 272, pl. VI, fig. 8.

Unio asperrimus Lea. Trans. Amer. Phil. Soc., IV, 1831, p. 71, pl. V, fig. 3.

Shell moderate to large, solid, thickest anteriorly, compressed or moderately inflated, quadrate in outline. Anterior margin and the anterior third of the ventral margin one regular and almost circular curve, remainder of the ventral margin straight or slightly incurved; posterior margin slightly curved, straight, or emarginate; dorsal margin straight or a little curved, slightly oblique, connecting with the posterior slope at an angle of from 90 to 120 degrees. Umboidal ratio, 0.25 to 0.40. Umbones small, moderately elevated, incurved, ornamented with small, double-looped nodulous ridges. Anterior umboidal slope rather fully rounded; lateral slope more or less grooved with a broad, shallow, radial furrow, the sides of which are commonly ornamented with an irregular band of tubercles, which is made up of many small and a few large, tear-like projections. These bands rarely extend to the ventral margin, and the posterior is generally the shorter of the two. Postumboidal ridge generally well marked and posterior slope generally slightly excavated and more or less pustulose dorsally. Epidermis fairly smooth and sometimes shiny, in color from greenish horn to dark chestnut-brown. The umbones of the young shells are often covered with a large triangular patch of dark green. Lines of growth numerous, raised, and

continuous. Ligament thick, dark brown. Lunule long and narrow.

Interior: Pseudocardinals high, pyramidal, ragged, single in the right and double in the left valve, the right pseudocardinal being surrounded by a shallow, rounded ditch. Laterals straight or curved, long, high, oblique. Interdentum variable, cut away for the right valve to receive the left posterior pseudocardinal. Anterior adductor cicatrix semicircular in outline, fairly deep. Posterior cicatrices slightly larger than the anterior ones, well marked, confluent. Pallial line well impressed for its anterior two-thirds. Dorsal scars a row of pits on the lower surface of the interdentum and pseudocardinals. Cavity of the beaks large and deep, of the shells moderate. Nacre pearly white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
106	96	67	0.36	112°	(18.1)
105	65	47	.24	110°	(320.1)
82	69	48	.31	93°	(322.1)
90	65	41	.30	115°	(321.1)
79	63	40	.33	122°	(19.1)

Q. lachrymosa is found in the St. Lawrence basin and the Mississippi drainage. It ranges southwest into Texas. It is a common species in all the Kansas systems and particularly abundant in the eastern Kansas drainage. It has been reported as far west as the Smoky Hill river at Salina. This species is not at all choice as to habitat. It often rivals *Obovaria ellipsis* as a habitant of sand-bars, and is also found in mud or shingle in water of variable depth.

The shell is as variable as its environment. The epidermis may be greenish yellow or dark brown, the tubercles numerous and erect or few and obscure. The size of the adult shell is also a variant. The shells of the animals living in muddy stations are large and massive; those from sand-bars thinner and smaller. The author found in a large series of material taken from beds of shingle in the Wakarusa river that the mean relation of the length to the height was 1.110 : 1.000. The extremes were 1.029 : 1.000 and 1.218 : 1.000, respectively.

The chief distinctions between this and other members of the *lachrymosa* group will be found under *Q. aspera* and *Q. fragosa*.

Quadrula fragosa CONRAD. Plate LXXXII, fig. 1.

Unio fragosus Conrad, Mon. Fresh-water Shells, II, 1836, p. 12, pl. VI, fig. 2.

Shell of moderate size, fairly thick, thickest anteriorly, quadrate in outline. Anterior margin and the first half of the ventral margin a full curve; posterior half of the ventral margin slightly incurved; posterior margin almost straight and at right angles to the posterior half of the ventral margin; dorsal margin straight or slightly curved, slightly oblique. Umboidal ratio variable, from 0.20 to 0.30. Umbones of moderate height and inflation, incurved, tuberculate. Anterior umboidal slope smoothly rounded; lateral slope marked posteriorly by a wide radial furrow, along each side of which is a row of erect, prominent tubercles, which run from the umbones to the margin; minor tubercles are scattered among the major ones, particularly those of the anterior series; posterior umboidal slope somewhat excavated and covered with a series of small, irregular plications, which are gently bowed ventrally. Lines of growth fairly continuous and prominent. Epidermis horn color to seal-brown. Ligament short, of moderate thickness, light brown in color. Lunule small.

Interior: Pseudocardinals large, erect, serrate, double in the left and single in the right valve. Interdentum broad and short, quite oblique. Anterior adductor scar placed in front of the pseudocardinals, set slightly under the anterior left pseudocardinal, small, quite deeply excavated, with a level floor. Posterior scars of moderate size, impressed, distinct. Pallial line impressed for the greater part of its length Dorsal muscle scars few but well marked, placed on the lower surface of the pseudocardinals. Cavity of the shell moderately large, of the beaks large. Nacre silvery white, iridescent on the posterior half.

Length.	Height.	Breadth.	Um. ra.	
76	62	41	0.20	(245.1)
62	50	29.5	.30	(244.1)
62	53	38	.28	(280.1)

This species is found in the Ohio, Cumberland and Tennessee river drainage systems and ranges west into Kansas, Nebraska, and Minnesota. In Kansas it is confined to the southern drainage system. It has also been reported from

Soldier creek, a tributary of the Kansas river from the north, but I think that it is quite possible that this is a mistake. In my collecting this shell has always been a rare one.

Although closely related to *Q. lachrymosa*, the species at hand is quite a distinct one. The anterior umboidal slope is less extensive than in *Q. lachrymosa*, and the tubercles are more numerous and erect. The posterior umboidal slope is covered with tubercular transverse plications. The same region of *Q. lachrymosa* bears scattered tubercles only.

Quadula speciosa LEA. Not figured.

Shell entirely covered with tubercles, almost quadrate, much compressed, the sides flattened, almost equilateral. Posterior margin slightly biangular and emarginate; anterior margin rounded; hinge fairly heavy, beaks subelevated, sharp, with fine undulations; epidermis greenish yellow, somewhat furrowed, sometimes obscurely rayed, sometimes eradiate, a little shiny; cardinal teeth fairly large, compressed oblique, erect, striate, double in either valve; lateral teeth straight, fairly long, oblique. Nacre pearly and iridescent.

This form ranges from Kansas south to Texas. I have never found it in the state, but Mr. W. H. Dall informs me that it has been collected from the Smoky Hill river. It is one of the lachrymose *Unios*. Its nearest ally in Kansas waters is *Q. fragosa*. The description is a translation of Lea's original one.

Quadrula pustulosa LEA. Plate LXXXIII, fig. 1.

Unio pustulosus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 76, pl. VII, fig. 7.

Unio dorfeuillianus Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 73, pl. XVII, fig. 54.

Unio schoolcraftensis Lea. Trans. Amer. Phil. Soc., V, 1834, p. 37, pl. III, fig. 69.

Shell of medium size, solid, often quite heavy, orbicular or roundly quadrate, compressed or subinflated. Anterior margin circularly rounded; ventral margin slightly to decidedly bowed, sometimes slightly produced posteriorly, and at an angle of from 90 to 120 degrees; posterior angle straight or gently bowed and meeting the dorsal margin at an extremely variable angle; dorsal margin either straight or bowed,

slightly oblique. Umboidal ratio not a constant, varying from 0.15 to 0.35. Umbones vary in height, with moderate inflation, to low and uninflated; ornamented with from three to five broken ridges, but free from pustules. Anterior umboidal slope fully rounded; lateral slope fully or flatly rounded and sometimes bearing a shallow and faint radial furrow; posterior slope generally incurved and often abrupt. The posterior and lateral slopes bearing pustules which may be numerous and cover most of the disk, or may be few and obscure; they are irregular in position and the pustules on the opposite valves do not always correspond; pustules lachrymosal in character but variable in size and outline. Epidermis light horn to dark chestnut-brown in color, the younger and lighter colored specimens ornamented over the umbones and sometimes half-way down the disk with a very broad, triangular green ray, which tends to break up into a number of finer ones; a similar ray is often present on the posterior slope. Lines of growth well marked, darker than surrounding epidermis. Ligament of variable length, stout.

Interior: Pseudocardinals rather heavy, ragged, double in the left and single (with sometimes an anterior and posterior auxiliary) in the right valve; the left pseudocardinals generally but not always joined dorsally; right pseudocardinal large and heavy, surrounded by a pit. Anterior adductor scars deep, semicircular or quadrant-like in outline, extending somewhat under the anterior pseudocardinal in the left valve. Posterior scars rather large for the size of the shell, well impressed, distinct or fused. Pallial line impressed about two-thirds of its length. Dorsal scars in a row on the lower surface of the interdentum and upon the base of the pseudocardinals. Cavity of the umbones quite large, of the shell small.

Interdentum broad and short. Laterals very variable in length, curved or straight, highest posteriorly, set at right angles to the longer axis of the pseudocardinals. Nacre satin or pearly white.

Length.	Height	Breadth.	Um. ra.	Dorsal posterior angle.	
57	50	36	0.22	114°	(41.1)
60	47	18	.20	115°	(463.1)
56	49	33	.25+	130+°	(724.1)
45	45	31	.18	140°	(464.1)
52	43	26	.34	115°	(466.1)

Q. pustulosa ranges over the entire Mississippi drainage and into Michigan, it extends east into the Alabama river system and west to central Texas. It is quite common throughout the Kansas drainage systems. It is found in streams of some size, either in gravel or mud bottom.

Q. pustulosus is one of the most variable species of an extremely variable group. It is hardly possible to write a description of this form which will cover all its varied mutations. The general outline may assume almost any form except a decidedly elongate one, and the umboidal ratio has absolutely no stability. The pustules may crowd the disk or the shell may be practically smooth. The pseudocardinals and laterals are subject to much variation both as to position and to form, and the interdentum may be broad and long or almost absent.

The main distinctions between this and other nearly related forms will be found under the latter.

Quadrula pustulata Lea. Plate LXXXIII, fig. 2.

Unio pustulatus Lea, Trans. Amer. Phil. Soc., 1834, p. 79, pl. vii, fig. 9.
Unio nodulatus Say, Amer. Conch., vi, 1834.

Shell rather small, solid, particularly so anteriorly, suborbicular but for a square dorso-posterior projection, inflated. Anterior margin and anterior half of the ventral margin circularly rounded; posterior half of the ventral margin straight or slightly emarginate; posterior margin straight or very slightly incurved, meeting the dorsal margin at an approximate angle of ninety degrees; dorsal margin straight, oblique. Umboidal ratio, 0.20 to 1.35. Umbones very full, fairly high, decurved, bearing three or four small concentric ridges on their tips. Anterior umboidal slope fully rounded, as is also the lateral one; posterior slope abrupt anteriorly, very flatly curved posteriorly, being produced dorso-posteriorly into a sort of triangular wing, which, however, is in no way

analogous to the alæ of the true winged *Unios*. Lateral slope ornamented with two radial rows of small, erect pustules, arranged linearly, and from three to five in number, sometimes with a group of irregularly placed pustules at the marginal end of the rows; posterior slope bearing a few obscure pustules arranged in five or six transverse rows. Epidermis light to dark horn color, with sometimes a light cast of green; young specimens show a green triangular patch over the umbones. Lines of growth far removed, considerably darker than the epidermis of the body of the shell. Lunule small and cordate in outline. Ligament stout and thick.

Interior: Pseudocardinals large for the size of the shell, erect, ragged, double in the left and single in the right valve; the left anterior pseudocardinal generally the larger, the right pseudocardinal arising from a pit. Interdentum broad but very short. Laterals at right angles to the free edge of the interdentum, straight or slightly curved, oblique, fairly long. Anterior adductor cicatrix deeply excavate, semicircular in outline, placed in front of the pseudocardinals; posterior scars small, lightly impressed, confluent. Pallial line impressed its anterior two-thirds. Dorsal cicatrices on the base of the pseudocardinals. Cavity of the shell small, of the beaks rather large. Nacre milk-white, very slightly iridescent posteriorly.

Length.	Breadth.	Height.	Um. ra.	
46	41	33	0.24	(475.1)
47	42	32	.32	(476.1)

Quadrula pustulata occurs in the lower half of the Mississippi drainage, in the Ohio river system, and in southern Michigan. In Kansas it is found only in the Verdigris river and the Neosho, in the southern drainage.

Q. pustulata is generally confused with its near ally, *Q. pustulosa*. It is, however, quite a distinct species. In the form under discussion the dorso-posterior angle is produced in a manner rarely found in *pustulosa*, and the arrangement of the tubercles is entirely different. The tubercles of *Q. pustulosa* are scattered irregularly over the disk; those of *Q. pustulata* are arranged in two radial rows which extend from the umbones to the ventral margin; they are set far apart, at

fairly regular intervals. The upper one or two tubercles of the posterior series are sometimes lacking.

Quadrula houstonensis LEA. Not figured.

Unio houstonensis Lea. Proc. Acad. Nat. Sci. Phila., III, 1859, p. 155.

Shell large, thick, moderately inflated, very roundly quadrate, slightly broader below than above. Anterior margin straight or very slightly curved above, abruptly rounded below; ventral margin regularly curved; posterior margin slightly curved and set at about right angles to the ventral margin; dorsal margin straight or slightly curved, oblique. Umbones large, full, high, directed a little anteriorly. Anterior and lateral umboidal slopes full and rounded; posterior slope somewhat truncate and very slightly incurved. Epidermis dark yellow, with smooth, rounded and regular lines of growth, which may be imbricated posteriorly. Ligament high, thick, and of moderate length. Lunule large.

Interior: Pseudocardinals of moderate size and light, double in the left and single (with sometimes a small anterior auxiliary) in the right valve; the left pseudocardinals being low and pyramidal, and arranged as the legs of a broad ∧, the right arising from a deep, ragged pit. Interdentum broad and long. Laterals short, thick, very oblique, curved, highest posteriorly. Anterior adductor cicatrix deep, not large, elongate, roundly triangular in outline. Posterior scars rather small, well impressed, distinct. Dorsal scars in a long row on the under surface of the interdentum and pseudocardinal. Pallial line well impressed its entire length. Cavity of the shell moderate, of the beaks deep and compressed. Nacre silver-white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
73	70	48	0.13	(46.1)

This species is found in Texas, Louisiana, southern Arkansas, and Kansas. It is reported from Mill creek, in the Kansas system (Call), and in the Verdigris (Call) and Spring river. It is not a common species. It resembles smooth specimens of *Q. pustulosa*, but is smooth, heavier and larger than that species.

Quadrula rubiginosa LEA. Plate LXXXIV, fig. 2.

Unio rubiginosus Lea, Trans. Amer. Phil. Soc., III, 1829, p. 427, pl. VIII, fig. 10.

Shell moderate in size, subinflated, solid, elongate and roundly quadrate. Anterior margin fully rounded; ventral margin slightly curved anteriorly, straight or a little emarginate posteriorly; posterior margin straight or slightly curved, more or less produced; dorsal margin straight, slightly oblique, meeting the posterior margin at an approximate angle of 130 degrees. Umboidal ratio, 0.15 to 0.25. Umbones full but not much elevated, ornamented with four to eight rough concentric ridges. Anterior margin fully rounded; posterior position of the lateral slope occupied with a very wide radial furrow; posterior umboidal ridge generally sharp and well defined almost its entire length; posterior slope fairly abrupt and in most cases a little excavated. Epidermis greenish horn to deep chestnut-brown in color, sometimes possessing a cloth-like texture. Lines of growth at irregular intervals and generally of a darker color than the surrounding epidermis. Lunule rather large, elongate. Ligament fairly stout, long or short; color variable.

Interior: Pseudocardinal fairly large, rough, double in the left, single in the right valve. Anterior left pseudocardinal an erect pyramidal ridge, posterior left roundly pyramidal; posterior pseudocardinal heavy and erect, high, surrounded by a trench into which the left pseudocardinals fit. Interdentum very variable in length and breadth. Laterals long, curved or straight oblique. Anterior adductor cicatrix quadrate in outline, deeply excavated; posterior scars deeply impressed, distinct or confluent. Pallial line impressed for one-half its length. Cavity of the beaks rather large, of the shell small. Nacre white or pinkish, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
65	46	25	0.21+	137°	(211.1)
78	53	37	.15+	136°	(207.3)
65	45	25	.23	127°	(475.1)
61	44	32	.21	133°	(213.1)

Q. rubiginosa ranges from the St. Lawrence and Nelson rivers, in Canada, to eastern Texas. It is a common species

in all the Kansas river systems, but is most plentiful in the Marais des Cygnes. It is an inhabitant of muddy river-beds.

The variation is considerable. The elongation of the posterior slope, the excavation of the radial furrow and the inflation all exhibit it to a marked degree. The young specimens generally bear a series of green rays over the umbones, but this character is not often present in the adult shell.

The two species with which *rubiginosa* might be confused are *Q. trigona* and *Q. coccinea*. Under the descriptions of these two species will be found a statement of the main distinguishing characters.

Quadrula trigona LEA. Not figured.

Unio trigonus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 110, pl. XVI, fig. 40.

"Shell trigonal, thick and heavy, much inflated, broadly rounded, and behind the posterior margin being produced ventrally; dorsal margin curved; ventral margin more or less sinuous; surface more or less shining, roughened by lines of growth; umbones large, elevated, inflated, dark brown, directed anteriorly, and unmarked except by growth lines; anterior umboidal slope short and flatly rounded; posterior slope strongly angled, with an excavation on each side of the angle, which reaches from the apex to the ventral border, where it forms a decided beak-like projection; viewed anteriorly, the shell is strongly heart-shaped, resembling in this respect some cardia, particularly *Isocardia cor*. Ligament short, wide, stout, very dark brown or black; epidermis reddish or blackish horn, unmarked by rays; cardinal teeth double in the left and single in the right valve, very stout, generally not much elevated, triangular, diverging, very deeply grooved and striated; lateral teeth short, solid, elevated, lamellar serrated, directed and curved ventrally; the right lateral and the lower left lateral have each a depression and a rudiment of an additional tooth; connecting bridge thick, wide, flat, smooth; anterior adductor muscle scar forming a truncated oval, very deeply excavated, striated; posterior adductor muscle scar oval, well impressed, striated; *protractor pedis* muscle scar wider than long, deeply

impressed, striated; *retractor pedis* muscle scar oval, very deeply pitted, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth and the under side of the connecting bridge, deep, large; pallial line impressed; cavity of the beaks deep; nacre silvery white, more or less iridescent." (Baker, 2.)

Q. trigona occurs throughout the Mississippi drainage, north into the St. Lawrence and south into Alabama. It has been reported from all the larger streams of southern Kansas and from Bull creek at Paola (Call), in the Marais des Cygnes drainage.

Trigona is close to *Q. rubiginosa* but is a more inflated and heavier shell, with more massive dentation.

Quadrula coccinea CONRAD. Plate LXXXIV, fig. 1.

Unio coccineus Conrad, Mon. Fresh-water Shells, III, 1836, p. 29, pl. XIII, fig. 1.

Shell of moderate size and solidity, suborbiculate in outline, slightly compressed. Anterior margin flatly or fully rounded, ventral margin gently bowed; posterior margin biangulate, produced below, straight or slightly curved, quite oblique, set at an angle; dorsal margin straight or slightly curved, oblique, joining the posterior margin at an angle of from 130 to 150 degrees. Umboidal ratio extremely variable. Umbones quite high and moderately full, marked with numerous fine concentric ridges and three coarse broken ones. Lateral and anterior slopes flatly rounded; posterior slope slightly incurved; posterior umboidal ridge not prominent, rounded. Epidermis smooth, shining, over umbones horn color to dark reddish brown, with the umboidal region covered with bright green rays of variable width. Lines of growth coarse, heavy, and often imbricated. Ligament thick, of moderate length. Lunule cordate.

Interior: Pseudocardinals of medium size and variable height, double in the left and single in the right valve, the right pseudocardinal surrounded by a trench. Interdentum long, width variable, cut away in the right valve. Laterals long, oblique, straight, or slightly curved, heavy, striate, sometimes double in each valve. Anterior adductor scars

semicircular in outline and quite deep, rather small when compared to the size of the shell; posterior scars distinct, well impressed, the adductor cicatrix quite elongate. Dorsal muscle scars small pits scattered on the lower surface of the interdentum. Cavity of the shell not large, of the umbones small. Nacre white or salmon-pink.

Length.	Height.	Breadth.	Um. ra.	D. p.-V. p. angle.	
65	50	34	0.10	130°	(53.1)
64	48	35	.21	140°	(401.1)
69	51	31	.17	140°	(Coll. K. S. A. C.)
77	56	40	.29	145°	(402.1)

Q. coccinea is found throughout the Mississippi and St. Lawrence drainage basins. It is common to all the Kansas river systems. I have never found it abundant, although it is generally present in all streams of any size. It is rare in the Wakarusa river at Lawrence and absent from the Kansas river there.

The variation is mainly in the color of the epidermis and the thickness of the shell. The shells from the clear-water rivers of the southern drainage are heavier than those from the Kansas and Marais des Cygnes. The nacre of *coccinea* is either pink or white. The white form is the commoner one.

This species is often confused with *Q. rubiginosa*. *Rubiginosa* is more sharply and distinctly biangulate and produced posteriorly than is *coccinea*. The posterior portion of the ventral margin of *Q. coccinea* is slightly rounded, that of *Q. rubiginosa* is emarginate. *Q. trigona* is distinguished from *Q. coccinea* by its much inflated beaks.

Quadrula solida LEA. Plate LXXXV.

Unio solidus Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 13, pl. V, fig. 13.
Unio fulgidus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 164.

Shell moderate to large in size, very thick and solid, particularly in region of the beaks, roundly quadrate or triangular, subinflated. Anterior margin flattened above, rather abruptly rounded below; ventral margin almost straight, slightly incurved centrally. Posterior margin straight or curved, sometimes slightly incurved centrally, a little produced ventrally; dorsal margin more or less oblique, straight or curved, sometimes forming one unbroken curve

with the posterior margin. Umboidal ratio, from 0.15 to 0.20. Umbones large, full, high, bluntly incurved, directed forward, very slightly ornamented with a few coarse, concentric ridges. Anterior umboidal slope very abruptly curved, in some cases almost straight dorsally; lateral slope fully rounded, bearing a very faint, broad groove extending from the posterior portion of the ventral margin about one-half the distance up the slope; posterior umboidal slope rather abrupt and sometimes slightly excavated. Epidermis smooth in young and rough in old specimens, honey color to black; young specimens ornamented over the umbones with dark green, narrow rays. Lines of growth coarse, crowded, and imbricated. Lunule very large. Ligament long, thick, dark brown.

Interior: Pseudocardinals very heavy, large, erect, ragged, double in the left and single (with sometimes an anterior and a posterior auxiliary) in the right valve; the left pseudocardinals light, running to an edge, arranged in the form of a V or U; the right pseudocardinal broad and truncated and surrounded by a deep ∨-shaped trench. Interdentum broad, flat, and long. Laterals short, thick, straight or curved, very oblique. Anterior adductor cicatrix elongate, small, deeply pitted, the left one communicating with the trench about the left pseudocardinal. Posterior scars large, deeply impressed, distinct. Dorsal muscle scars arranged in a long row on the lower surface of the pseudocardinals. Pallial line impressed almost its entire length. Cavity of the shell slight, of the beaks deep but compressed. Branchial outline well marked dorsally. Nacre satin-white.

Length.	Breadth.	Height.	Um. ra.	
72.5	52	67	0.16+	(Coll. K. S. A. C.)
70	44	64	.20	(319.1)
68	47	61	.155	(Coll. W. C.)
47	34	42	.15+	(Coll. W. C., juvenile.)

Solida is distributed throughout Mississippi drainage. Locally it is found in the Neosho, the Verdigris and the Walnut rivers, of the southern drainage. It is to be found on gravel-bars and is not a rare species.

Q. solida possesses the most massive shell of any Kansas *Unio*. It is closely related to *Q. coccinea* and *Q. plena*, but it

is much more massive and quadrate than either of these forms. The beaks of this form are more elevated than those of *Q. coccinea*.

The pseudocardinals of *solida* are particularly characteristic, being larger in proportion to the size of the shell than any other Kansas *Unio*.

Quadrula plena LEA. Not figured.
Unio plenus Lea, Trans. Amer. Phil. Soc., VIII, 1843, p. 211, pl. XIV, fig. 3.

Shell large, thick particularly anteriorly, inflated in the umboidal region, roundly triangular or ellipsoid in outline. Anterior margin straight or slightly curved above, decidedly curved below; ventral margin straight or very slightly incurved; posterior margin curved, sometimes a little produced below; dorsal margin long, straight, oblique. Umboidal ratio, less than 0.10. Umbones very full, high, incurved and recurved. Anterior umboidal slope very abruptly curved below, incurved above; lateral slope moderately rounded, sometimes bearing a faint, broad radial furrow; posterior slope narrow, abrupt, sometimes slightly incurved. Epidermis shiny over the umbones, dark horn to black in color. Lines of growth prominent. Lunule large, very variable in shape. Ligament rather short, thick, and stout.

Interior: Pseudocardinals low and stumpy, rough and serrate, double in the left valve and single in the right; anterior left pseudocardinal small, often thin, posterior left pseudocardinal a broad truncated pyramid, serrate on top; right pseudocardinal the highest of the set, surrounded by trench. Interdentum broad but very short; laterals very long, slightly curved, not very heavy, continued to the ligament dorso-anteriorly. Anterior adductor cicatrix rather small for the size of the shell, very deeply excavated, quadrant-like in outline, confluent with the anterior retractor cicatrix; posterior scars well impressed, distinct. Pallial line impressed for its anterior two-thirds. Dorsal cicatrices a line on the lower surface of the interdentum. Cavity of the shell rather large, of the beaks moderate. Nacre white or salmon-pink.

Length.	Height.	Breadth.	Um. ra.	
88	62	47	0.06	(317.1)
85	60	44	.09	(460.1)
85	62	47	.045	(Coll. K. S, A. C.)
62	48	37	.06	(461.1)
78	54	45	.08	(462.1)

Q. plena is found in the Ohio, the Cumberland and the Tennessee river drainages, and extends west into Kansas, Indian Territory, and Arkansas. It is found only in the clear-water rivers of the southern drainage in the state. It is fairly common, being found on the gravel-bars of the larger streams. *Plena* varies considerably in its elongation. The older specimens are much longer in proportion to their height than are the younger ones. The shells have either pink or white nacre, in my experience. The form having the pink nacre is the more abundant.

The main differences between this form and *Q. solida* and *Q. ebenus* is noted under the descriptions of those species. *Q. pyramidata* is much more liable to be confused with *plena* than are either of the above species; it is, however, a higher shell, with more elevated umbones and a more flattened or emarginate anterior margin.

Quadrula pyramidata LEA. Not figured.

Unio pyramidatus Lea. Trans. Amer. Phil. Soc., IV, 1834, p. 109, pl. XVI, fig. 39.

Unio mytiloides Deshayes Encyclopédie Méthodique, Historie des Vers, par Bruguière et Lamarck, II, 1830, p. 586, pl. CCXLIX, fig. 4.

Shell moderate in size, heavy, thick anteriorly, much thinner ventro-posteriorly, elliptical, triangular in outline. Anterior margin straight or slightly incurved above, rather abruptly rounded below; ventral margin straight or a little incurved, slightly oblique, short; posterior margin slightly rounded; dorsal margin quite long, oblique. Umboidal ratio, from 0.05 to 0.09. Beaks very much elevated, incurved and decurved. Anterior umboidal slope very abrupt, and bearing a very slight furrow running from the anterior side of the umbones to the upper part of the anterior margin; lateral slope much higher anteriorly than posteriorly, and bearing a narrow, radial flattened area, corresponding in position to the radial furrow in some related forms; posterior slope very abrupt and slightly incurved. Epidermis dark brown, with

numerous regular but hardly continuous lines of growth, sometimes possessing a cloth-like texture. Ligament fairly stout and long.

Interior: Pseudocardinals massive, ragged, double in the left and single in the right, the right pseudocardinal arising from a deep pit; laterals long, fairly heavy, very slightly curved, oblique, tending to double in the right as well as in the left valve. Interdentum very short, broad. Anterior adductor cicatrix small, quadrant-like in outline, very deep. Posterior scars much impressed, distinct, the adductor cicatrix broader behind than before. Pallial line well impressed in its anterior half. Dorsal cicatrices a line on the lower surface of the interdentum and the base of the pseudocardinals; cavity of shell moderate, of the beaks shallow and a little compressed; branchial depression deep but not distinctly outlined; nacre a warm pink, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
60	42	41	0.06	(Coll. W. C.)
70	54	44	.085	
32	28	....	.08	

Q. pyramidata is found in the Mississippi drainage, north of the states of Mississippi and Louisiana. It has been reported from the Verdigris and Neosho rivers in Kansas. It has only been reported from two localites, and is apparently a rare species.

There is no species but *Q. plena* that can be confused with *Q. pyramidata*. A discussion of the differences between these two closely related species will be found in the notes on *Q. plena*.

Quadrula ebenus LEA. Not figured.

Unio ebenus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 84, pl. IX, fig. 14.

Shell of moderate size, solid, broadly elliptical in outline. Anterior margin flatly rounded; ventral margin slightly bowed; posterior margin rounded but sometimes showing a tendency to be biangulate; dorsal margin oblique, straight or slightly curved. Umboidal ratio, 0.10 or less. Umbones full, of moderate height, incurved, and directed anteriorly. Anterior umboidal slope fully curved; lateral slope rather

flatly rounded and bearing a radial flattened area, which corresponds with the radial groove present in other closely related species. Posterior slope abrupt and straight. Epidermis smooth and shining over the umbones, dark brown to black. Lines of growth very regular, rounded, and continuous, imbricated marginally. Ligament long, high, dark brown. Lunule small and narrow.

Interior: Pseudocardinals of moderate size, low heavy, ragged, double in the left and single in the right valve. The anterior left pseudocardinal a low, pyramidal ridge joining at a wide angle with the posterior tooth, which is an elongate, truncately pyramidal ridge; right pseudocardinal high and ragged, surrounded by a pit. Interdentum broad and long, depressed in the right valve. Laterals short, thick, oblique, curved. Anterior adductor cicatrix very deep, an elongate quadrant in outline; posterior scars rather small, well impressed, distinct. Dorsal cicatrices on the lower surface of the interdentum forming a line. Pallial line impressed its entire length. Cavity of the beaks and of the shell moderate. Nacre white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
72	55	38	0.09	(470.1)

Q. ebenus is found throughout the Mississippi valley generally, except for the northwestern portion. Call reports it from the Kansas river at Topeka. It is also present in the Neosho river at the southern state line and at Burlington.

The shell can be separated from the other heavy *Quadrulas* of its type by its greater compression, less inflated and anteriorly directed beaks, and widely elliptical outline. The outline of all the nearly related forms is roundly triangular.

Two other *Quadrulas* have been reported from Kansas by Call (4), *Q. rubida* Lea and *Q. spherica* Lea. As both these species are confined, except for this one locality, to the eastern streams flowing into the Gulf of Mexico, I withhold them from this catalogue until I have more data concerning them. Simpson (20) states that Call's *Q. rubida* is probably a somewhat sulcate *Q. rubiginosa*.

Key to the Kansas Unionidæ.

This key is a purely local and artificial one. It is intended only to supplement the figures and descriptions in the identification of species.

I. Shell Rough.
- A. Shell bearing undulations across the disk.
  - a. Undulations confined to the posterior slope, laterals not present. *Symphynota costata.*
  - b. Laterals present.
    - 1. Umbones high and full. *Quadrula plicata.*
    - 2. Umbones fairly high and full; shell decidedly broader behind than before; plications regular. *Quadrula perplicata.*
    - 3. Umbones compressed.
      - 1¹. Umbones smooth except for slight ridges on their tips. *Quadrula undulata.*
      - 2¹. Umbones very pustulose. *Quadrula heros.*
- B. Shell ornamented with coarse concentric folds on the lateral slopes, very heavy; beaks placed far forward. *Pleurobema cicatricosum.*
- C. Shell with a very pronounced umboidal ridge, which is ornamented with several large, irregular nodules.
  - a. Shell decidedly elongate, pseudocardinals small. *Quadrula cylindrica.*
  - b. Shell roundly quadrate, pseudocardinals large. *Quadrula metanevra.*
- D. Shell elongate with strong umboidal ridge, tubercular anterior, generally brokenly plicate posteriorly. *Tritogonia tuberculata.*
- E. Shell roundly triangular, lateral slopes bearing a single radial row of erect tubercles 3-5 in number. *Obliquaria reflexa.*
- F. Shell pustulose.
  - a. Pustules arranged in two radial rows on either side of a shallow radial furrow.
    - 1. Pustules confined to the dorsal half of the disk, shell produced posteriorly. *Pleurobema æsopus.*
    - 2. Pustules generally extending over the surface of the disk, shell quadrate. Group of *Quadrula lachrymosa.*
  - b. Pustules irregularly scattered over the disk, shell sometimes almost epustulate. Group of *Quadrula pustulosa.*

II. Shell Smooth.
- A. Neither laterals nor pseudocardinals present.
  - a. Beaks hardly apparent.
    - 1. Shell small and cylindrical. *Anodonta gracilis.*
    - 2. Shell large and circular in outline. *Anodonta suborbiculata.*
  - b. Beaks of moderate inflation and elevation.
    - 1. Shell large, hinge line straight in front of the umbones, relation of length to breadth as 2 is to 1. Group of *Anodonta grandis.*
    - 2. Shell of only moderate size, hinge line slightly incurved in front of the beaks; shell drawn out to a point posteriorly. *Anodontoides fiorussacianus.*
  - c. Shell with extremely high and inflated beaks. *Anodonta opaca.*
- B. Laterals absent, pseudocardinals present as mere rounded knobs. *Steophitus edentulus.*
- C. Pseudocardinals well developed, laterals indicated only by one low ridge on each valve. Shell often alate. *Symphynota complanata.*
- D. Laterals and pseudocardinals present.
  - a. Shell alate.
    - 1. Nacre pinkish in the cavity and over the dentition of the shell, pseudocardinals small, rounded knobs. *Lampsilis gracilis.*
    - 2. Nacre deep purple pink all over the interior of the shell.
      - 1¹. Shell very thin, pseudocardinals extremely lamellar. *Lampsilis lævissima.*
      - 2¹. Pseudocardinals of moderate size and typical form; shell square posteriorly. *Lampsilis alata.*
      - 3¹. Shell only slightly alate, inflated, subsolid, pseudocardinals of typical form, epidermis generally black. *Lampsilis purpurata.*

II. SHELL SMOOTH.

D. Laterals and pseudocardinals present.

b. Shell non-alate.

1. Shell thin or at most subsolid, body of shell somewhat or decidedly inflated, rays often present over the disk, pseudocardinals small, sharp-pointed, erect. Interdentum absent or narrow, long, and rounded.

1¹. Shell with moderately high and inflated beaks, two-thirds as high as long, generally yellow with greenish rays, strongly dimorphic.

a¹. Shell small and roundly triangular. *Truncilla triquetra.*

b¹. Shell large and very broadly elliptical, often strongly truncate posteriorly. *Lampsilis ventricosa.*

2¹. Shell with low uninflated beaks.

a¹. Shell roundly triangular, with very erect pseudocardinals and sharp and elevated umboidal ridge.

aa. Shell inflated and almost circularly triangular. *Plagiola elegans.*

bb. Shell rather compressed and elliptically triangular. *Plagiola donaciformis.*

b.¹ Shell elliptical.

aa. Shell small (not over 40 mm. in length), epidermis cloth-like, beaks coarsely undulate.

* Posterior margin rounded. *Lampsilis parva.*

** Posterior margin pointed. *Lampsilis texasensis.*

bb. Shell large.

* Shell very fragile and somewhat compressed, pseudocardinals degenerate.

† Shell obscurely rayed, large, generally yellow, nacre pinkish. *Lampsilis gracilis.*§

†† Shell decidedly rayed, nacre silver white. *Lampsilis leptodon.*

** Shell thin or subsolid, pseudocardinals not degenerate.

† Shell rather broadly elliptical, with a regularly rounded posterior margin.

‡ Shell subsolid, ligament quite large; pseudocardinals large for this group and rounded. Interdentum present. Group of *Lampsilis ligamentina.*

‡‡ Shell fairly thin, pseudocardinals fairly pointed, ligament not large. Interdentum absent or degenerate; females greatly inflated posteriorly. Group of *Lampsilis luteola.*

†† Shell elongate, elliptical pointed posteriorly.

‡ Shell rather compressed, eradiate, epidermis bearing concentric bands of different shades, monomorphic. *Unio tetralasmus.*

‡‡ Shell not compressed, rays present except in the very dark members; color of epidermis not arranged concentrically; dimorphic.

0 Shell rather small (not over 75 mm.), seal brown, umbones covered with many fine widely V-shaped crenulations. *Lampsilis subrostrata.*

00 Shell fairly large, generally polished straw color, with bright green rays. Group of *Lampsilis fallaciosa.*

000 Shell very dark, polished eradiate, nacre white, pink, or purple. *Lampsilis recta.*

II. Shell Smooth.

D. Laterals and pseudocardinals present.

b. Shell non-alate.

2. Shell solid, compressed, beaks low and compressed, pseudocardinals fairly heavy, interdentum present and prominent.

a. Shell roundly triangular in outline.

a¹. Shell, with broad, green rays, incurved ventral margin and lateral furrow. *Cyprogenia alberti.*

b¹. Shell without lateral furrow, ventral margin not incurved. *Plagiola securis.*

b. Shell elongately ellipsoid in outline.

a¹. Shell broadly or narrowly ellipsoidal; epidermis light to dark brown, with fine hair rays posteriorly; beaks with very fine crenulations. Groups of *Phychobranchus phaseolus.*

b¹. Shell generally narrowly elliptical; epidermis dark brown or black, eradiate; beak sculpture a few very coarse concentric folds; nacre white, pink, or purple. *Unio gibbosus.*

c. Shell quadrate, sometimes with green rays over the umbones. *Quadrula rubiginosa.*

3. Shell roundly elliptical, triangular or quadrate, inflated in the umboidal region or just posterior to it, solid, pseudocardinals heavy and ragged, the right pseudocardinal surrounded by a trench.

a. Shell fairly solid, roundly triangular or quadrate, beaks not high. Group of *Quadrula trigona.*

b. Shell solid, roundly elliptical, beaks not high.

a¹. Beaks full but not high; epidermis honey-brown with sometimes a greenish cast. *Obovaria ellipsis.*

b¹. Beaks rather compressed; epidermis very dark brown or black. *Quadrula ebenus.*

c. Shell roundly triangular, high, with full, high, rounded, incurved beaks, very solid, with very large pseudocardinals. Group of *Quadrula plena.*

d. Shell suborbicular, heavy, large, with rather full, high beaks. *Quadrula houstonensis.* (This will also include the smooth, circular forms of *Q. pustulosa.*)

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§This is intended as check on the forms of *L. gracilis* which have lost their alæ.

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